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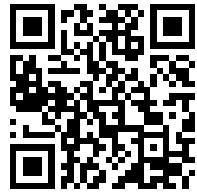

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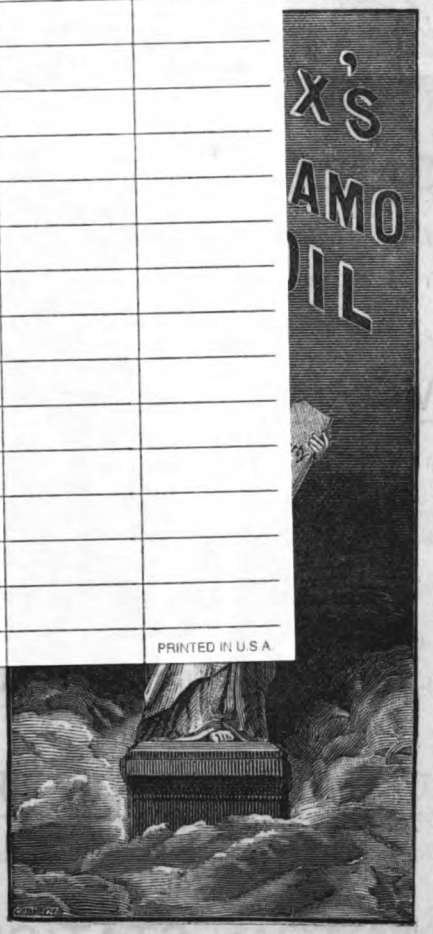

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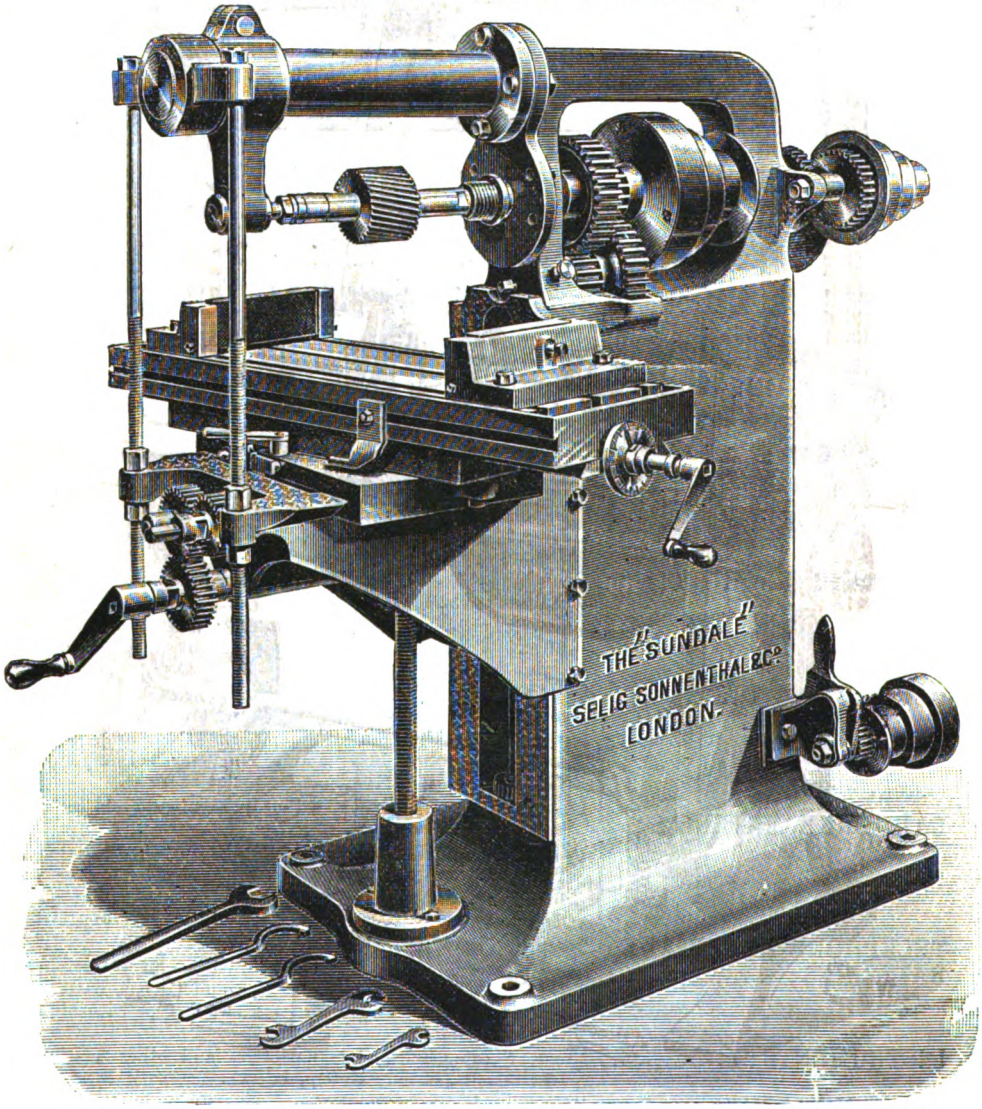

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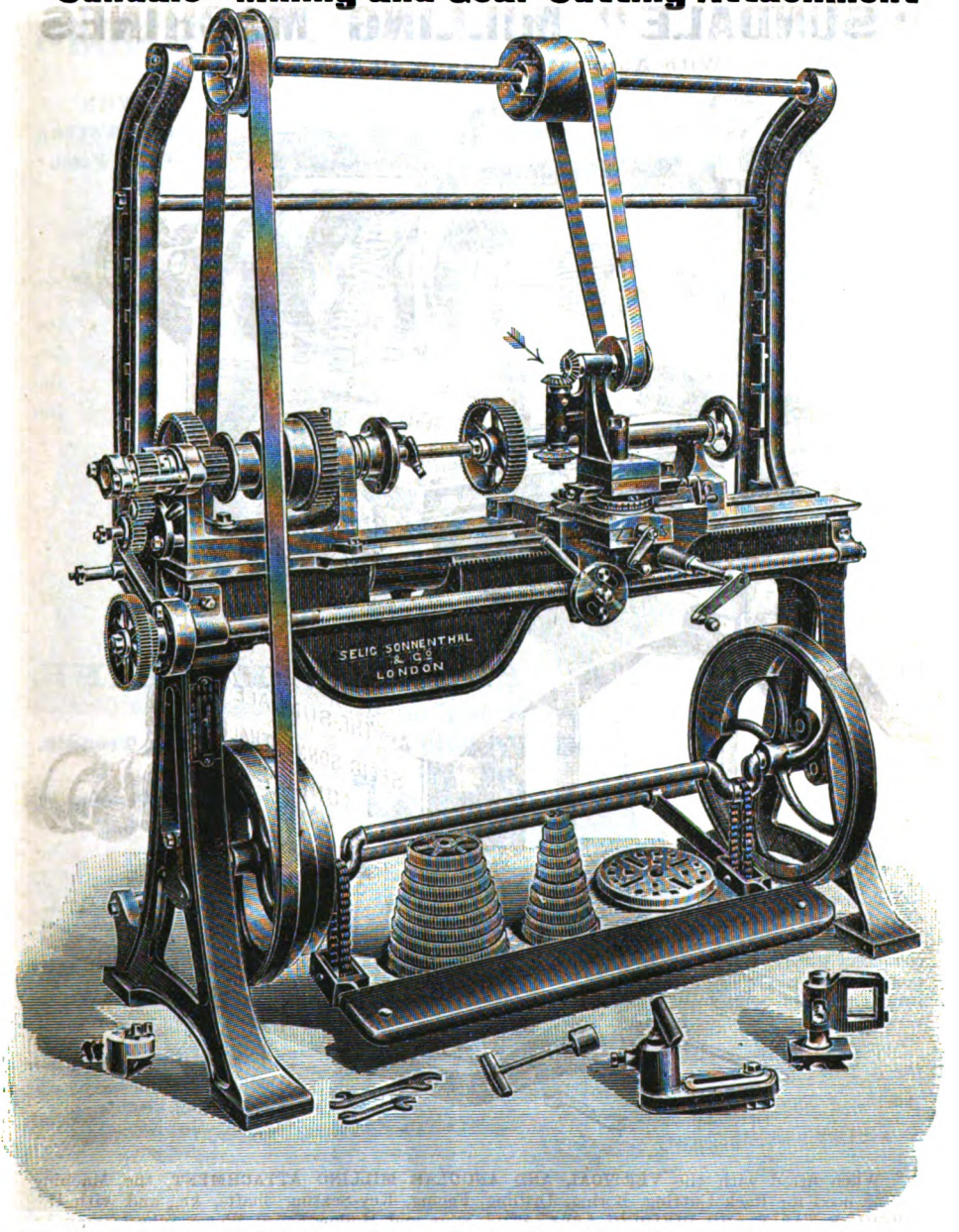

"VICTORIA" Hollow Spindle Screw Cutting Treadle Lathe with self-contained overhead motion, and "SUNDALE" Gear Cutter.

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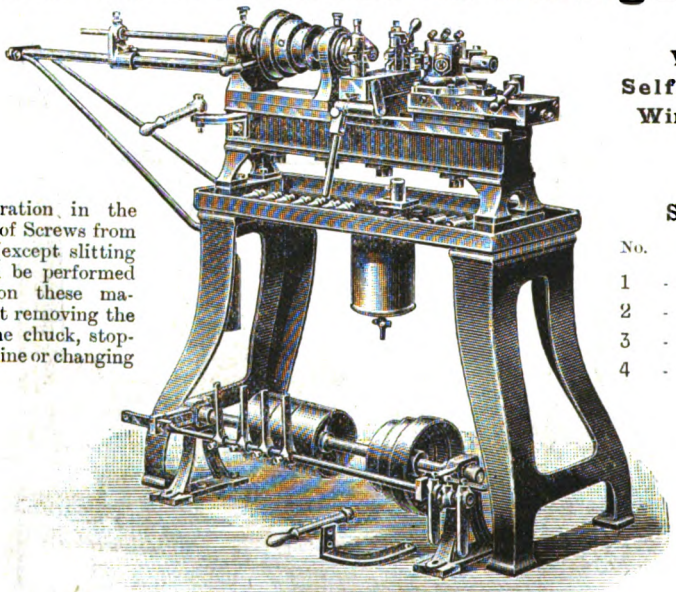

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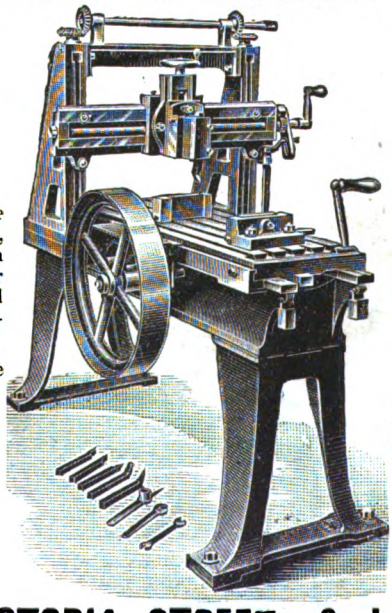

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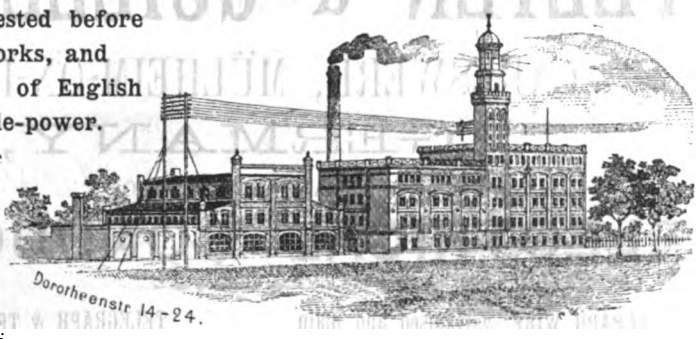

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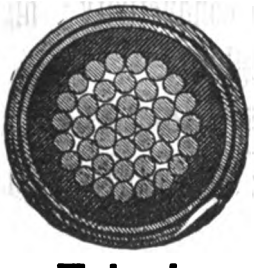

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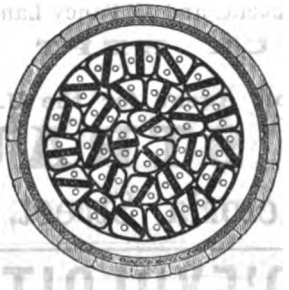

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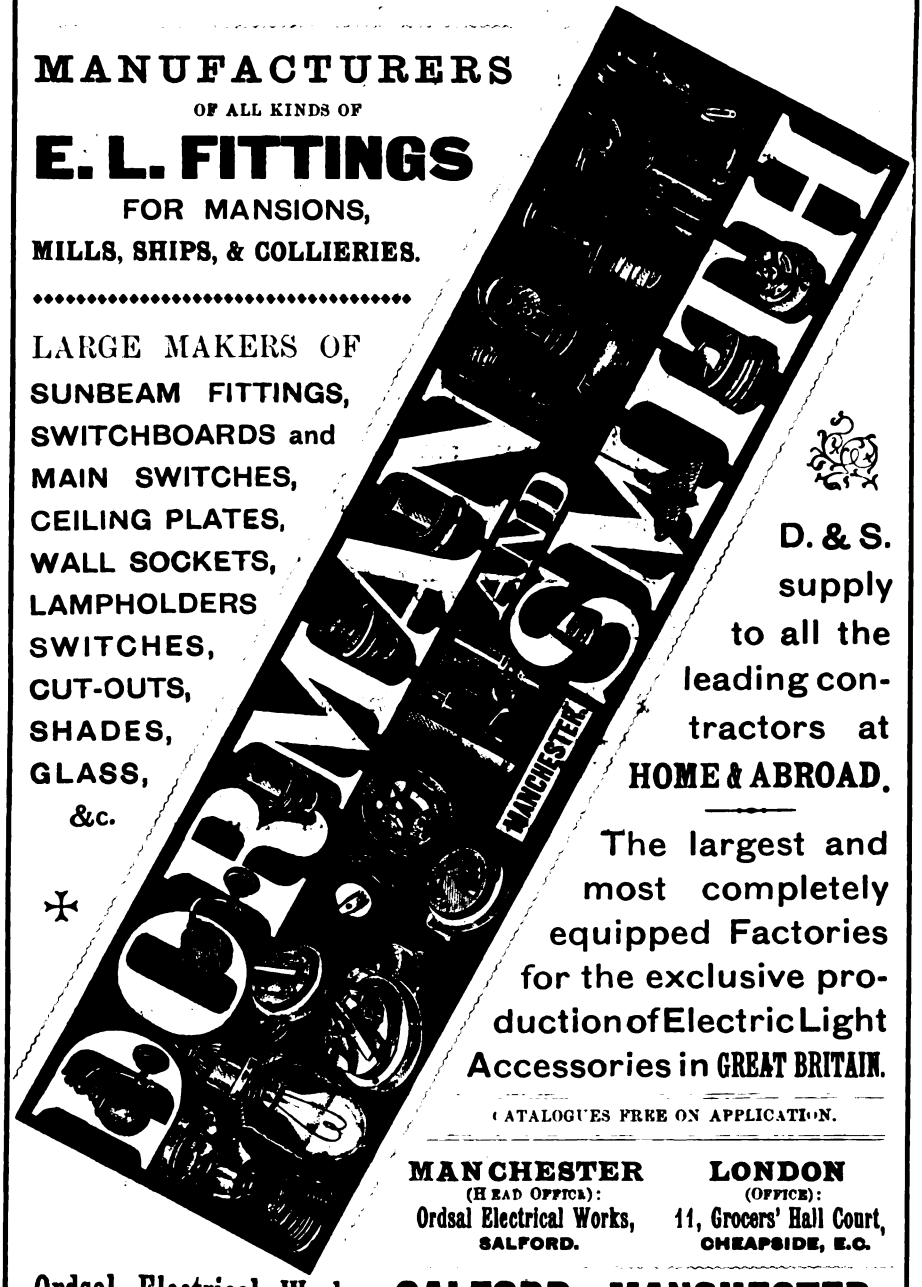

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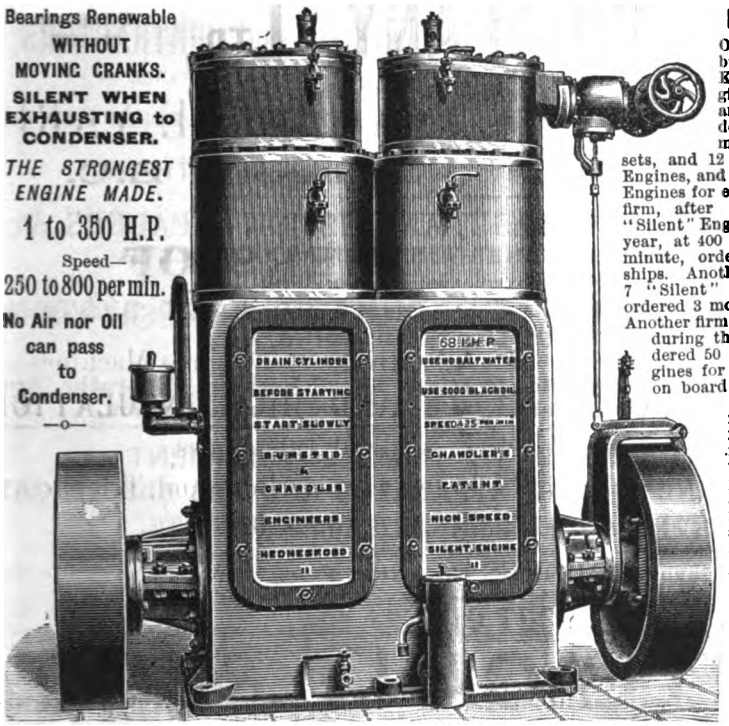

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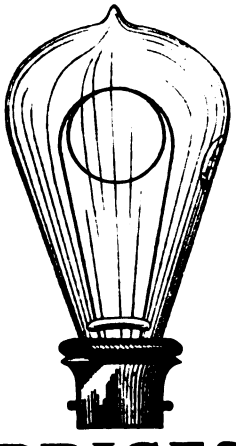

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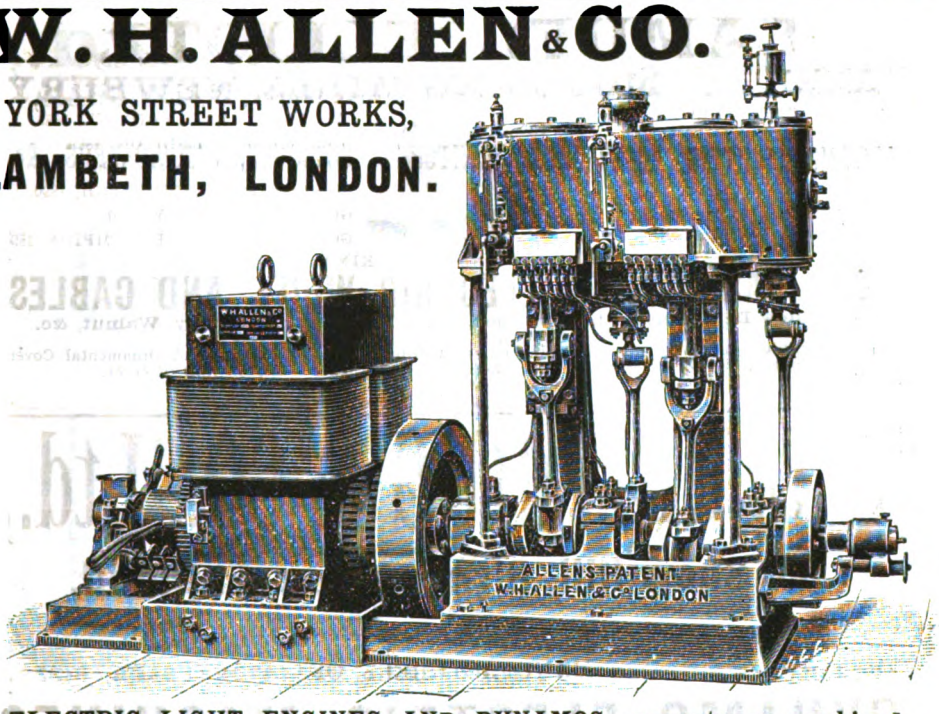

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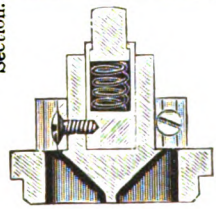

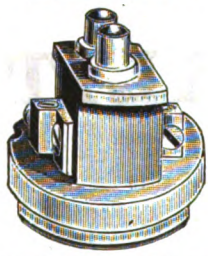

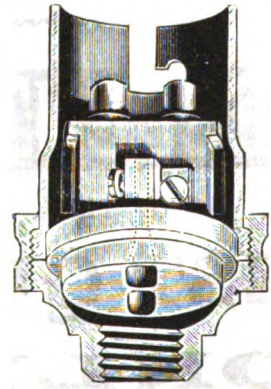

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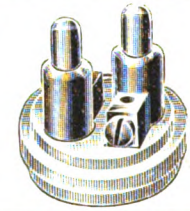

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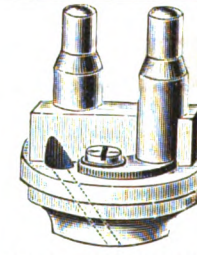

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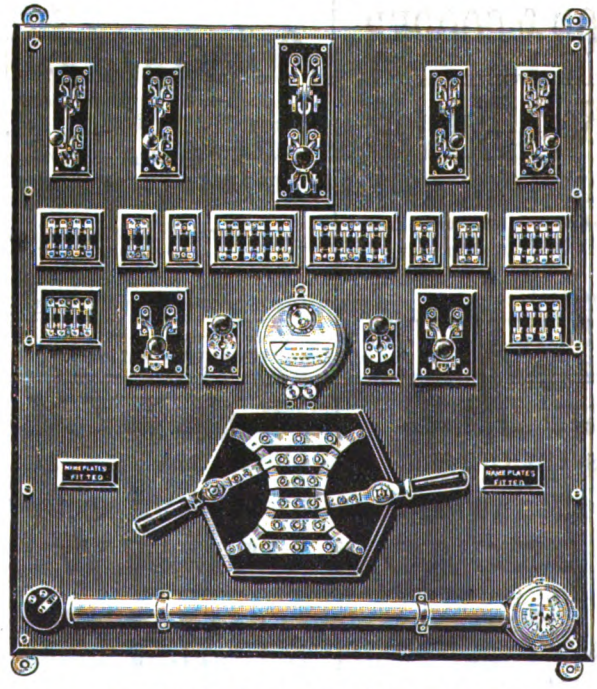

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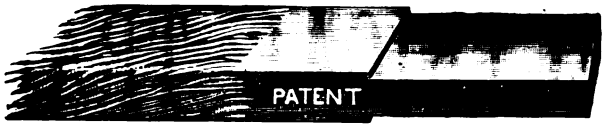

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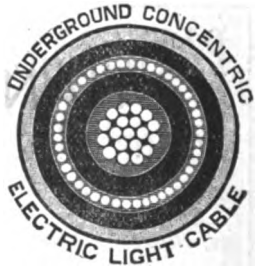

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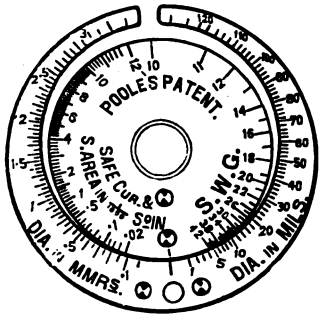

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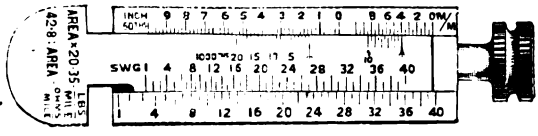

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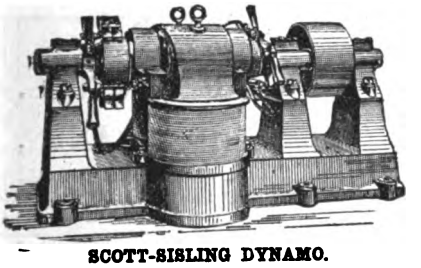

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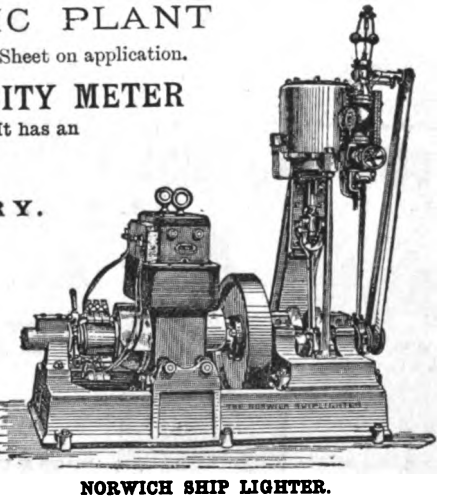

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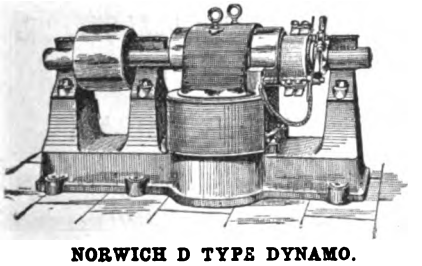

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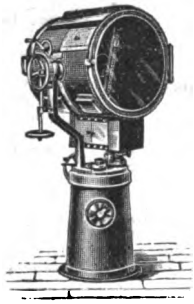

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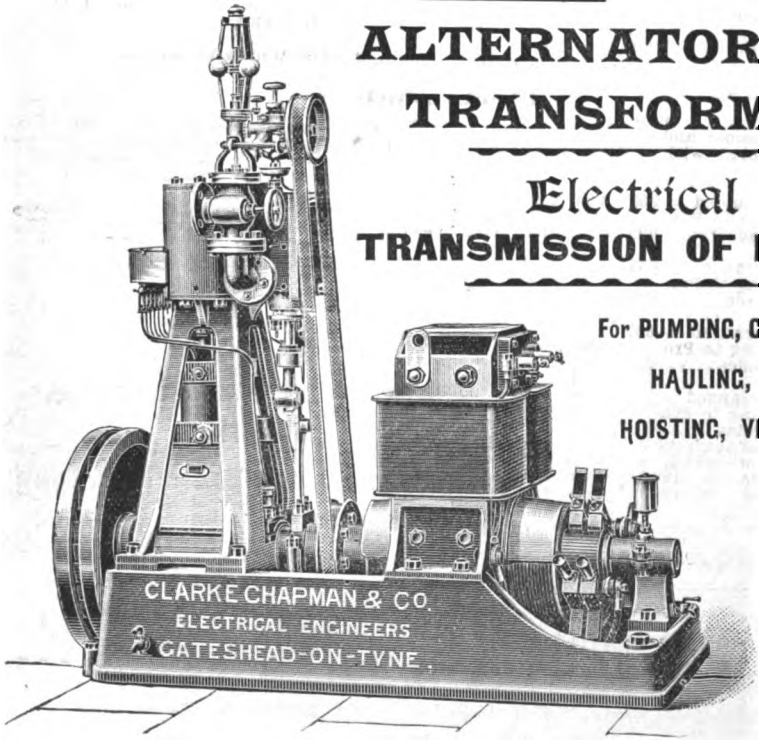

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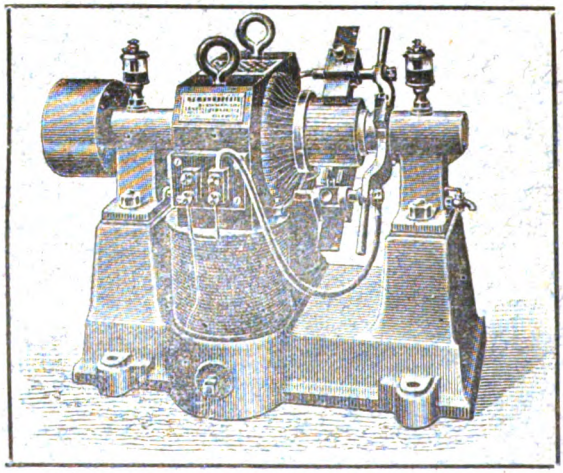

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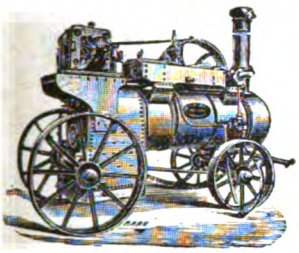

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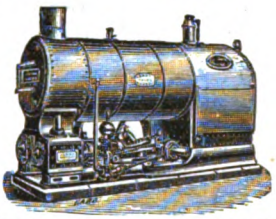

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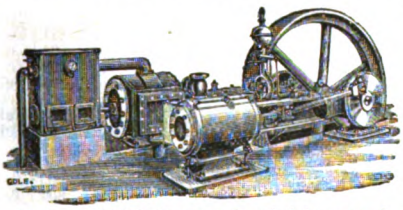

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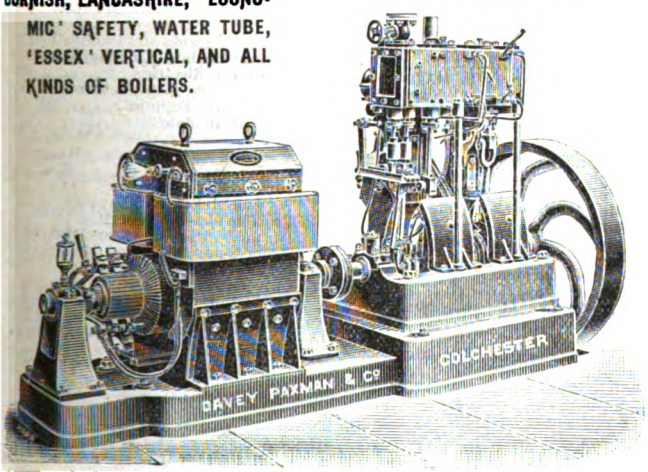

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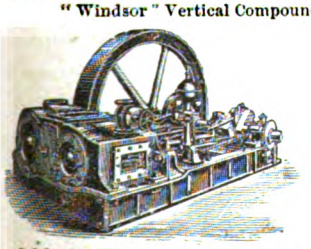

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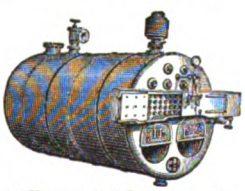

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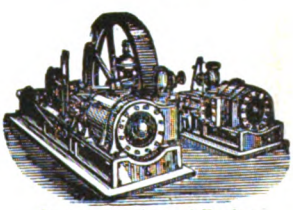

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TWELFTH YEAR'S ISSUE.

PREFACE.

IN issuing this, the Twelfth Edition of our annual DIRECTORY AND HANDBOOK, we have again to renew the Editors' and Publisher's acknowledgments and thanks for the assistance and support they have received from the Electrical Trades generally, both at home and abroad. As regards the reference DIRECTORY it is as complete and authentic as our best efforts can make it, and in these respects it has won a high place in the ranks of Trades' Directories of every kind. If there are any shortcomings we may confidently plead that the fault rests with the parties concerned, who, through forgetfulness or inadvertence, fail to put us in possession of the needful information or correction in time for publication. These omissions, however, become fewer each year as the importance of publicity becomes more and more fully recognised; and this present year's issue leaves little room for criticism in this respect.

The enlarged space occupied by the DIRECTORY section of the work affords gratifying evidence of the unceasing growth of the Electrical and allied Trades, of their increasing activity, and of their tendency to group themselves into a commercial union lending power and dignity to their combined industries when dealing with Governments and Municipalities. To these advantages the Colonies and the Continent have contributed not a little; and we have this year given them greater prominence by assigning them separate sections, more easily distinguished and handier for reference. We have reason to believe that ours are the only Colonial and Continental lists accepted as trustworthy by the trade, and we take this opportunity of thanking the Colonial and Continental Press for their unstinted appreciation of our efforts in this difficult work.

Several fresh statistical and electrical tables of interest and importance to professional electricians and electrical traders have been embodied in

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the present volume, together with other new matter arising out of electrical developments or legal pronouncements during the past year. On the other hand, a judicious elimination has been made of matter which has taken a permanent place in standard works of the day, or has grown out of date, or been superseded by later experiments and research.

To keep our clients well informed of the best and latest in respect of all particulars likely to be useful to them and to advance the progress of electrical science and manufacture, has been our constant endeavour; and that we have succeeded in these efforts may be fairly assumed from the ever-increasing bulk of its pages and the not less increasing prosperity of "THE ELECTRICIAN" ELECTRICAL TRADES' DIRECTORY AND HANDBOOK. The Advertisers in this Edition may be claimed as the most representative firms in the Allied Industries, and Government Departments, Municipal Authorities, and Wholesale and Retail Dealers may confidently refer to the Index of manufacturing firms, &c., on pages 53 and 54, with the full assurance that the names there set out are the principal makers of Electrical and General Engineering Plant, Apparatus and Appliances.

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SUMMARY OF ELECTRICAL EVENTS FOR 1893.

JANUARY.

The Australian Cable Rates raised at the request of the Colonial Governments (1st).
The Austrian Government took over the Exchanges of the Telephone Company of Austria (Limited) (1st).
Judgment given in the Action for Infringement brought by Dr. John Hopkinson against the St. James' and Pall Mall Electric Light Company. Mr. Justice Romer decides that Dr. Hopkinson's Three-Wire Patent, No. 3,576, of 1882, is valid (14th).
Opening of the Hull Municipal Central Station (16th).
Expiry of the Blake Telephone Transmitter Patent, No. 229, of 1879 (20th).
Publication of an Interim Report by the Royal Commission on Coast Communication recommending five Lightships and a certain number of Rock Lighthouses to be electrically connected with the shore (31st).
A Sub-Committee of the Glasgow Corporation report that they are of opinion that the disadvantages of electric traction outweigh its advantages.
Delivery by Prof. W. Cawthorne Unwin of a course of Howard Lectures on "The Development and Transmission of Power from Central Stations."
Belgian Telephone System taken over by the Government.
The American Institute of Electrical Engineers publish a series of important proposals with regard to the forthcoming International Electrical Congress at Chicago.
Dividends declared:—St. James' and Pall Mall Electric Light Company, 7¼ per cent.; Anglo-American Telegraph Company, 2¾ per cent.; Newcastle-upon-Tyne Electric Supply Company, 4 per cent.

FEBRUARY.

Expiry of the Crossley Telephone Transmitter Patent, No. 412, 1879 (1st).
Death of Mr. J. E. H. Gordon and M. van Rysselberghe (3rd).
Inauguration of the Liverpool Overhead Railway by the Marquis of Salisbury (4th).
Judgment given in favour of the Leeds Electric Cars by Mr. Justice Kekewich (National Telephone Company *v.* Graff Baker) (4th).
Opening of the Boston-Chicago Telephone Trunk Wire (1,200 miles long) (7th).
The price of the Board of Trade Unit reduced by the St. James' and Pall Mall, and Westminster and London Electric Companies, to 6d., with sliding scale discount down to a minimum of 5d.
New form of glow lamp with removable stopper, iron leading-in wires, and bottle-neck, brought out by the Westinghouse Company of America.
Death of Dr. Norvin Green, President of the Western Union Telegraph Company of America.
In an Action brought in America by the General Electric Company against the Beacon Vacuum Pump and Electric Company, the latter brought forward the Göbel Lamp as an anticipation of Edison's; Judge Colt decided that the Göbel Lamp did not warrant stay of preliminary injunction.
The Glasgow Municipal Electric Lighting Central Station comes into operation.

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Remarkable results in the reduction of refractory ores obtained by M. Henri Moissan by means of the electric furnace.

Meeting of the National Electric Lighting Association at St. Louis.

Dividends declared :—Kensington and Knightsbridge Electric Lighting Company, 4 per cent.; Telegraph Construction and Maintenance Company, 15 per cent.; Westminster Electric Supply Corporation, 3½ per cent.; Newcastle and District Electric Lighting Company, 5½ per cent.; Electricity Supply Corporation, 5 per cent.; India-Rubber, Gutta Percha and Telegraph Works Company, 7½ per cent.; Chelsea Electricity Supply Company, 2½ per cent.; Liverpool Electric Supply Company, 5 per cent.; Birmingham Electric Supply Company, 3½ per cent.; Keswick Electric Light Company, 2 per cent.

MARCH.

The Liverpool Overhead Electric Railway opened to the public (6th).

A motion in the House of Commons by Mr. Pickersgill to secure the insertion of a London County Council Purchase Clause in the City and South London Railway Bills defeated by a large majority (9th).

Tramway clauses in the Salford Corporation Improvement Bill withdrawn owing to the demand of the National Telephone Company for a protection clause (16th).

A Select Committee of the House of Commons decide that the preamble of the Clapham Junction and Paddington Railway Bill is not proved. Great opposition was offered by the authorities of the Central Institution and Royal College of Science to the line being taken up Exhibition-road within a few feet of the laboratories (20th)

Shareholders vote the voluntary winding up of Woodhouse and Rawson United (Limited) (20th).

Papers by Mr. C. K. Falkenstein, entitled "Notes on the Influence of Electricity in Tanning Operations," read before the Institution of Electrical Engineers (23rd).

Rejection of the Kilburn-Victoria Electric Railway Bill by a Select Committee of the House of Commons (24th).

Agreement signed between the Coventry Town Council and Mr. Graff Baker with regard to the working of the tramway system by electricity (31st).

Issue by the Board of Trade of an important memorandum on the effect of using glow-lamps in ships' side lights.

Publication of the Report of the Committee of Investigation appointed by the shareholders of Woodhouse and Rawson United (Limited).

Dundee Municipal Electric Lighting Station comes into operation.

The National Telephone Company announced certain reductions in their London tariffs.

Edison "Feeder" patent upheld in the United States.

Dividends declared :—W. T. Henley's Telegraph Works Company, 5 per cent.; Direct Spanish Telegraph Company, 4 per cent.; Anglo-Portuguese Telephone Company, 5 per cent.

APRIL.

Laying of a Post-Office Telephone Cable between Port Kail and Donaghadee (4th).

The shareholders of Elmore's French Patent Copper Depositing Company (Limited) vote its voluntary winding up (6th).

Death of Mr. C. V. de Sauty (11th).

Paper on "Distribution of Power by Alternate-Current Motors," read before the Institution of Electrical Engineers by Mr. Albion T. Snell (13th).

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The Islington Vestry decide to undertake electric lighting (18th).
Friday Evening Discourse at the Royal Institution by Prof. A. B. W. Kennedy, on "Possible and Impossible Economies in the Utilisation of Energy" (21st).
The Leicester Town Council decide to accept the Brush Company's tender for a municipal plant on the alternate-current transformer sub-station system (25th).
The Edinburgh Town Council decide to undertake electric lighting (25th).
The Glasgow Town Council appoint a Special Committee "to consider the question of applying to the Postmaster-General for a licence to supply the community with an efficient telephone service."
Dividends declared:—Eastbourne Electric Light Company, 3 per cent.; Metropolitan Electric Supply Company, 2 per cent.; Hastings and St. Leonard's-on-Sea Electric Light Company, 5 per cent.; Eastern Extension Telegraph Company, 7 per cent.; Indo-European Telegraph Company, 10 per cent.; Great Northern Telegraph Company, 8·6 per cent.; London-Platino-Brazilian, 2 per cent.; New Shanghai Electric Light Company, 7 per cent.; Western Brazilian Telegraph Company, 2½ per cent.; Submarine Cables Trust, 6 per cent.

MAY.

The Faure Accumulator patent upheld by the Court of Appeal in France (5th).
Death of Sir James Anderson (7th).
Paper by Mr. W. B. Sayers, entitled "On the Prevention and Control of Sparking: Continuous-Current Dynamos without Winding on the Field-Magnets, and Constant-Pressure Dynamos without Series Winding," read before the Institution of Electrical Engineers (11th).
Death of Prof. Moses G. Farmer, at Chicago (25th).
Halifax and Ealing decide to borrow £30,000 and £25,000 respectively for electric lighting purposes.
Cardiff authorised to spend £32,500 on electric lighting.
Dividends declared:—Reuter's Telegram Company, 5 per cent.

JUNE.

Important Presidential Address dealing with Gas and Electricity, delivered by Mr. Denny Lane to the Incorporated Gas Institute, at Belfast (13th).
Inquiry by a Joint Committee of both Houses of Parliament as to the telephone protective clauses which should be inserted in private Bills relating to electric traction (19th, 20th, 21st, 22nd, 23rd, 26th, and 27th).
Action brought against the St. James' and Pall Mall Electric Light Company by the trustees of the Windham Club for nuisance, settled out of Court; similar action brought against the Electricity Supply Corporation was given in its favour.
Sanction given to electric lighting loans: Aberdeen, £20,000.
Dividends declared:—Electric and General Investment Company, 25 per cent.; Consolidated Telephone Construction and Maintenance Company, 2 per cent.; Eastern Telegraph Company, 6½ per cent.

JULY.

Publication of the Report of the Joint Committee on Electric Powers (Protective Clauses). Tramways obliged to use insulated or uninsulated returns, telephones to metallicise their circuits (13th).

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Action brought by a Strand clockmaker against the Electricity Supply Corporation for damages and an injunction, resulted in the jury deciding that while there was vibration it was very slight (14th).

Death of M. Marié Davy (16th).

Death of Mr. S. E. Phillips (22nd)

The Commissioners of Sewers decide to sanction the running of telephone wires in the spare tubes of the City of London Electric Lighting Company only upon condition that double-wire circuits, good instruments, and £8 rentals are guaranteed (25th).

Opening of the Huddersfield Municipal Central Lighting Station (29th).

The Tunbridge Wells Town Council decide to adopt an electric lighting scheme costing £13,000.

Death of Mr. Oliver Smith.

Dividends paid :—National Telephone Company, 5 per cent.; Direct United States Cable Company, 3½ per cent.; Globe Telegraph and Trust Company, 4⅝ per cent.; Sheffield Electric Light and Power Company, 5 per cent.; Edison-Swan United Electric Light Company, "A" shares, 10 per cent.; Oriental Telephone and Electric Company, 2¼ per cent.; Manchester Edison-Swan Company, 5 per cent.

AUGUST.

The Manchester Municipal Electric Lighting Station comes into operation (1st).

The Glasgow Town Council adopt the recommendation of their Telephone Committee and decide to apply to the Postmaster-General for a telephone licence (3rd).

International Electrical Congress held at Chicago. Important Papers were read by Prof. Ayrton on Phenomena connected with the Electric Arc, and by Prof. Silvanus Thompson on Ocean Telephony; and an International System of Electrical Units and Nomenclature was adopted (21st-25th).

The Southport and Cheltenham Town Councils decide to adopt the high-pressure system of electric lighting; the Stafford Town Council decide to adopt the low-pressure system of electric lighting; and the Worcester and Coventry Town Councils definitely decide to adopt the alternate-current high-pressure system.

The Zipernowsky-Déri patent for running transformers in parallel, and the Zipernowsky-Déri-Bláthy patent for closed magnetic circuit transformers upheld by the Court of Appeal in France.

The Postmaster-General refuses to grant a telephone license to the Glasgow Corporation.

Cable laid by the Telegraph Construction and Maintenance Company between Lisbon (Portugal) and the Azores.

Dividends declared :—Electrical Power Storage Company, 5 per cent.; Cuba Submarine Telegraph Company, 8 per cent.; Brush Electrical Engineering Company, 6 per cent.

SEPTEMBER.

Opening of the Municipal Electric Lighting Station at Whitehaven (2nd)

Opening of the Stockholm-Christiania Telephone trunk line (2nd).

Opening of the British Association Meeting at Nottingham (13th).

Postmaster-General promises to present the Agreement between the Post Office and the National Telephone Company to the House of Commons in November (19th).

Death of Mr. H. Weaver (20th).

Reduction of the price of glow lamps by the Edison-Swan United Company, from 3s. 9d. to 1s. 9d. (21st).

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Bill introduced into the United States Senate directing experiments to be made with a view to the establishment of electrical communication with outlying lighthouses and lightships.

OCTOBER.

Death of Sir Arthur Blackwood, Secretary to the Post Office (4th).
Opening of the Derby Central Station (10th).
Opening of the Queensland-New Caledonia Cable (19th).
Important Paper on "The Artificial Lighting of Workshops" read by Mr. B. A. Dobson before the Institution of Mechanical Engineers (25th).
Inauguration of the Blackpool Municipal Station by Lord Kelvin.
Bolton municipal electric lighting loan of £40,000 sanctioned by the Local Government Board.
The Electricity Department of the Bradford Corporation report a net profit for the financial year, after payment of interest, sinking fund and arrears, of £1,269.
Dewsbury municipal electric lighting loan of £25,000 sanctioned by the Local Government Board.
Salford municipal electric lighting loan of £32,000 sanctioned by the Local Government Board.
Dividend declared:—Brazilian Submarine Telegraph Company, 6 per cent., plus a bonus of 1s. per share.

NOVEMBER.

Opening of the Kingston-on-Thames Municipal Electric Lighting Station (4th).
Paper on "The Electrical Transmission of Power from Niagara Falls" read before the Institution of Electrical Engineers by Prof. George Forbes (9th).
Expiry of the Edison Lamp Patent, No. 4,576 of 1879 (10th).
Issue of Draft Electric Tramway Regulations by the Board of Trade (22nd).
Mauritius cable opened for traffic (23rd).
Statement made by the Postmaster-General in the House of Commons that the loss upon press telegrams amounted to at least £300,000 a year (27th).
Death of Mr. Anthony Reckenzaun.
Strike of Italian telegraph clerks.
The Kensington Vestry reject a proposed municipal electric lighting scheme by a large majority.

DECEMBER.

Death of Prof. Tyndall (4th).
The Coventry Town Council accept the electric lighting tender of Messrs. John Fowler & Co., Leeds, and decide to borrow £20,000 for the purpose of carrying it out (5th).
The City Commissioners of Sewers decide to remove the gas lamps in all streets lighted by electricity (6th).
Formation of a Governmental Committee at Paris to inquire into the subject of the extension of the French telegraph system, more especially of the French cable system.
Statue of Joule in the Manchester Town Hall unveiled by Lord Kelvin (8th).
Death of Sir George Elliot (23rd).
Formation of the Northern Society of Electrical Engineers.
Death of Henry Göbel, deemed by some to be the inventor of the incandescent lamp.
Foundation stone of the Bolton Corporation Electricity Works laid.
Loan of £15,000 for carrying out a municipal electric lighting scheme at Yarmouth sanctioned by the Local Government Board.
Dividends declared:—Swan United Electric Light Company, 7½ per cent.

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OBITUARY NOTICES.

THE following is a record of the losses sustained by Electrical Science and Industry during 1893. The obituaries are in most cases compiled from the columns of *The Electrician*:—

Anderson, Sir James, J.P., F.R.G.S., F.G.S., F.S.S.—The death of Sir James Anderson, which took place on May 7th, after an illness of nearly three months' duration, removed an eminent figure from the submarine telegraph world. Sir James Anderson was born at Dumfries in 1824, joined the Merchant Service at the age of 16, and made several voyages to India and the West Coast of America. A few years later he went with his ship to Natal, Mauritius, Bombay, and traded between China and the Persian Gulf. In 1851 he entered the important service of the Cunard Steamboat Company, and commanded successively fourteen vessels belonging to that extensive company in the Mediterranean and the Atlantic. When the Telegraph Construction and Maintenance Company was formed for the purpose of laying the second Atlantic cable, the first having been irretrievably lost, the "Great Eastern" steamship was chartered to do the work, and it became a question as to who should command that ship. The choice fell on Capt. Anderson. In the first voyage of the "Great Eastern" the cable parted, and Capt. Anderson attempted to pick it up. He found, however, that the machinery at his disposal was not equal to the work, but felt confident that, with proper appliances, he could pick up the cable from the great depths of the Atlantic. On the return of the ship, Capt. Anderson so impressed the Directors of the Telegraph Construction Company with his views that they individually largely subscribed to the necessary capital, and the Board determined not only that the ship should be sent out to recover the cable that was lost, but also that a second cable should be laid, if they could find the amount of money necessary to enable them to have one manufactured. In both these projects they were entirely successful. The ship went to sea under Capt. Anderson's command, laid the new cable, and picked up the cable broken the previous year. For carrying out this important operation Capt. Anderson received the honour of knighthood. The fact that cables could be picked up from such great depths and repaired gave a wonderful impulse to submarine telegraphy. Sir James Anderson saw that there was a great future for it, and from that time he identified himself with the small band of men who have been the pioneers of submarine telegraphy. At the time of his death Sir James Anderson—whose connection with telegraphy has been fraught with most happy results for submarine telegraphy, he being an authority on cable matters—was Managing Director of the Eastern Telegraph Company, the Eastern and South African Telegraph Company, and the West African Telegraph Company; he was Chairman of the Brazilian Submarine and Direct Spanish Telegraph Companies, and a Director of the Anglo-American, the African Direct, the Eastern Extension, and the West India and Panama Telegraph Companies, and a Trustee of the Globe Telegraph and Trust Company. He was also a Director of the Metropolitan Electric Supply Company, and a Trustee of the Submarine Cables Trust. Sir James was a member of the Statistical Society, before whom he read a Paper on "Statistics of Telegraphy," afterwards publishing a book under the same title, which is regarded as an authority on the subject. He wrote also Papers on

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"Cables in Time of War," "The Government Purchase of Submarine Cables and Reduction of Telegraph Rates," "The Telegraphic Communication of the Empire and a Comparison of the Various Routes to the East." Sir James long advocated an "Authorised Vocabulary" from which the words used in code messages should be taken, and it was due to his efforts in this direction that the last International Telegraphic Conference decided to compile an official list of words to be used in codifying telegrams, which will be published this year. It can be said of Sir James Anderson that he endeared himself to all who came in contact with him. Endowed with a large measure of sterling common sense, of genial presence, possessed of the utmost kindness of heart, and availing himself of unnumbered opportunities of doing good to many besides those who had the honour of serving under him, he will be long remembered with very sincere affection and respect.

Archereau, Henry-Joseph.—The death of M. Henry-Joseph Archereau at the age of seventy-three occurred in February. M. Archereau made a name for himself in the middle of the century by his work on the Bunsen cell, and by his arc lamp. M. Archereau came to Paris in the last years of the reign of Louis-Philippe, and in 1849 made the sensible and obvious improvement to the Bunsen cell of placing the carbon inside and the zinc outside the porous pot, thus rendering the moulding of carbon cylinders unnecessary. He, at the same time, substituted retort carbon for the agglomerate carbon of Bunsen. About the time that M. Archereau came upon the scene many people were at work upon the task of getting rid of the noxious fumes given off by the nitric acid cell. Some tried hermetic sealing; others absorbents, such as oleic acid. M. Archereau attempted with but moderate success to overcome the defect by placing an inverted vessel containing iron filings over the cell. Another device of M. Archereau was an elaborate contrivance for filling and emptying large electric lighting batteries of a hundred or more cells, which could, it was claimed, be filled in this way in five minutes. In 1850, M. Archereau brought out an arc lamp in which the lower carbon holder was actuated by an iron-copper core moving within a helix of wire traversed by the main current, the balance being maintained by a counter-weight. Fortune did not smile on M. Archereau, but for many years he was maintained in comparative comfort by the liberality of the late M. Gaston Planté. A few years ago M. Archereau's friends got up a subscription on his behalf, but the small sum realised was wasted on profitless inventions, and M. Archereau finally died in misery.

Cowper, Edward Alfred.—By the death of Mr. E. A. Cowper in May a well-known figure was removed from Westminster, and the already scant number of engineers of the old school was reduced. Only a few weeks before his death he was taking part in the discussion at the Institution of Civil Engineers on the Paper by the late Mr. Willans, and characteristically advocated the use of the well-understood Prony brake instead of the rather mysterious dynamo for testing engines, nor did he let the opportunity pass for insisting, as he was wont, on the advantages of the steam jacket. Mr. Cowper served a seven-years' apprenticeship at the works of John Braithwaite, of St. Pancras, which he entered at the age of 14 in 1834. In 1847 he assisted in founding the Institution of Mechanical Engineers, becoming an original member of council, and was President in 1880-81. After active work with Messrs. Fox and Henderson he started in practice as a consulting engineer in 1851, joining in the following year the Institution of Civil Engineers, in the affairs of which he continued to take so active a part up to the last. In about 1857, after giving great attention to the subject of the economy of steam, he introduced the jacketted reservoir for compound engines with the cranks at right angles. This invention, well known as "Cowper's hot-pot," was applied to H.M.S. "Briton" in 1870; the coal consumption on the trial was 1·3lb. per horse-power per hour. Mr. Cowper was a thoroughly practical mechanical engineer, and had strong inventive abilities. He became a member of the Institution of Electrical Engineers in 1879, but did not concern himself much with electrical work. In

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this year, however, he invented the writing telegraph, an instrument which in principle is identical with the very latest apparatus proposed for this purpose. To all who were in the habit of attending the meetings of the Institution of Civil Engineers, Mr. E. A. Cowper was one of the best known members of council. It was the exception if he did not take part in the discussion on a Paper dealing with a mechanical subject, and he always had some bit of experience to recall, and often an invention of his own to describe with which to illustrate in a most practical manner the topic of the evening. In 1887, in conjunction with Dr. W. Anderson, he made a determination of Joule's equivalent on a large scale, a 5 H.-P. engine being run on a Froude dynamometer for many hours. The times are altering, and such men of mechanical instinct and long experience in a definite branch of a wide profession are becoming rare. The rising generation is more ready to display a knowledge of theory, to spend its strength on the last new thing, and to attempt to cover a wide range; may it give rise to a few men of the sound common sense of Mr. E. A. Cowper.

Cracknell, E. C.—Mr. E. C. Cracknell, Superintendent of the New South Wales Government Telegraphs, died at Sydney on January 14th, after a very short illness. Mr. Cracknell was born at Oxford in 1831, and proceeded to Sydney about the year 1855, where he organised the telegraph system in New South Wales, and remained at its head until his decease. His last visit to Europe was in 1885, when he attended the Telegraph Conference at Berlin.

De Sauty, Charles Victor.—The death, at the age of 63, of Mr. Charles Victor de Sauty took place from paralysis on April 11th at Gibraltar, where he was Superintendent of the Eastern Telegraph Company. Mr. De Sauty was born in 1830, and after some time spent in a solicitor's office, entered the Submarine Telegraph Company's service. In 1856 he joined the original Atlantic Telegraph Company, and was Superintendent of the Newfoundland Station during the short period the cable worked in 1858, and in the laying of which cable he took part as electrician. In 1859 he joined the firm of Glass, Elliot and Co., afterwards the Telegraph Construction and Maintenance Company, as their chief electrician, and was engaged upon all the expeditions for the laying of that firm's cables up to 1865, including the Atlantic cable of that year. He then went to New Zealand, and was in charge of the Government Telegraphs there until 1870, when he entered the service of the Falmouth-Gibraltar and Malta Telegraph Company, which was afterwards amalgamated, with three other cable companies, into the Eastern Telegraph Company. Although Mr. De Sauty had no regular training in that direction, he was a most ingenious mechanician, and kept well in the van of all the early development of electrical science and submarine telegraphy, in proof of which may be cited his method for the comparison of electrostatic capacity, which was the earliest differential method used for that purpose, and contained within it the elements of the duplex. Mr. De Sauty was largely concerned in the practical development of the duplexing of cables, which was finally perfected by the introduction of Dr. Alexander Muirhead's condensers. His name was better known on the American side, in connection with the laying of the first Atlantic cables, than that of any other member of the scientific staff, as is evidenced by the quaint but little known verses of Dr. Oliver Wendell Holmes. Mr. De Sauty was a man of strong personal character, expressing his opinions very plainly, and one of the staunchest friends it was possible to have.

Elliot, Sir George.—The death of Sir George Elliot, Bart., well known in the electrical world on account of his early connection with submarine telegraphy, occurred on Saturday, December 23rd. Sir George Elliot was a typical Englishman. Born at Gateshead in 1815, he began life at the bottom of a coal-pit, and worked through every stage of the industry with which his name was so widely connected. He early succeeded in creating for himself a fortune, which

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enabled him to take the place and exercise the influence belonging to energy of character, and shrewd, practical intelligence. In 1849 he acquired the business of Messrs. Kuper and Co., wire-rope makers, from the assignees of the firm, paying off their liabilities in full, and giving a handsome sum to Messrs. Kuper for the reversion. In this business he invited Mr., afterwards Sir, R. A. Glass to become a partner, and that gentleman, in 1852, first adapted the principle of wire-covering for submarine cables, which, successfully protecting them from the perils of the deep, had its share in the development of submarine cable industry to its present enormous proportions. The story of the laying of the Atlantic cable is well known. After the failure of the cable which had been successfully laid in 1858, the Company were, from 1858 to 1864, engaged in raising new capital, and scientific men were making improvements in the form of cable and in the apparatus for submerging it. Then the Telegraph Construction and Maintenance Company was formed, with Sir John Pender as Chairman, and absorbed the firm of Glass and Elliot and the Gutta Percha Company, and an entirely new cable, much thicker and more costly than the former one, was manufactured. The 2,300 miles, weighing more than 4,000 tons, of which this cable consisted, was shipped in 1865 on board the "Great Eastern," and when over 1,000 miles had been paid out the cable snapped by overstraining, and the end sank to the bottom. A new cable was constructed with a sufficient addition of the 1865 cable to repair the disaster of that year; and in 1866 both this new cable was laid and the lost cable of 1865 recovered and completed. The firm subsequently became, and is now known as, Elliot and Co., wire-rope makers, of Great George-street, Westminster; Cardiff and Durham. Sir George Elliot fought several severe political contests, and represented South Durham in Parliament for many years, receiving his Baronetcy from Mr. Disraeli in 1874. At the time of his death he was Chairman of the Telegraph Construction and Maintenance Company and a Director of the Metropolitan Electric Supply Company.

Farmer, Moses G.—Prof. Moses G. Farmer died in Chicago on May 25th. Although but little known to the present generation of electrical workers, he was one of the most accomplished electricians of his time. Born at Boscawen, N.H., in 1820, he manifested in early life great ability as a mathematician and a strong predilection for scientific pursuits. Illness and lack of means constrained him to relinquish his studies while yet in the midst of his college course, and to seek employment as a teacher. In 1845 his attention became directed to the study of electromagnetic phenomena, and from that day to the end of his life he devoted himself with unbounded enthusiasm and unceasing diligence to the study of electrical science with reference to its industrial applications. He entered the telegraphic service in the capacity of operator and inspector in 1847, having previously invented and built an electric locomotive, and acquired some local fame as an experimental lecturer on electricity and magnetism. His first notable achievement was the construction of the municipal electric fire-alarm of Boston, which he completed in 1851. The differentiated automatic signalizing apparatus; the control of powerful mechanical forces at a distance by a feeble electric current; the constantly closed circuit, in which signals were given by interruptions; the application to such circuits of the sustaining battery; the application of the magneto-electric current machine for the production of currents of great dynamic power, and of water-power for driving the magneto machines; the protection of conductors by placing them, insulated, in wrought-iron pipes; the protection of the signal stations from the destructive effects of lightning by the "plate-arrester"—all these, and innumerable minor devices essential to the efficiency and trustworthiness of the system, had to be originated by him, for there existed at that early day no precedents by which he could have been guided. The success of the electric automatic fire alarm for the first time demonstrated that electricity, when intelligently handled, was an agency which might be depended upon as implicitly as heat or gravitation to do its appointed work. A mere catalogue of Farmer's inventions and investigations for

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the next twenty years would fill pages; some of the most important of the former are the automatic repeater and the double-current system of duplex transmission, each of which now forms an indispensable part of the equipment of all the principal telegraphic systems of the world; the automatic printing telegraph; the automatic regulator for incandescent lighting systems; and, most important of all, the auto-exciting dynamo-electric machine. In this last, Siemens, Wheatstone, and Varley were independent inventors. Notwithstanding the benefits which his inventions and discoveries conferred upon the world, the story of the first fifty years of Farmer's life is one of almost incessant struggle against poverty, sickness, and discouragement. He was literally one of those men who have no time to stop to make money. In 1872 he was made professor of electrical science in the United States Naval Torpedo Station at Newport, a position most congenial to his tastes, and one in which he rendered the government most valuable service, until his increasing infirmities compelled his resignation in 1881. To Professor Farmer, perhaps, more than to any other man, may be traced the origin of the influences which have placed the United States at the head of the nations of the world in its industrial applications of electricity.

Gordon, J. E. H.—On Friday, February 3rd, whilst riding near Thornton Heath, Mr. J. E. H. Gordon's horse bolted, and, in turning a corner, threw him on to an asphalte pavement. He died an hour after his admission to the Croydon Hospital from extensive fracture of the skull. He was particularly fond of riding, and was considered an experienced and daring horseman. Although prominent latterly as an energetic contractor for the erection of electric supply stations in England and Ireland, Mr. Gordon's earlier work was perhaps the more important, and of this the building of his large dynamos was one of the most remarkable examples, judged, of course, with reference to the time, and not compared with the practice of to-day. Mr. Gordon was born in 1852, and was educated at Eton and Cambridge, with a short interval at King's College, London. He took his degree in mathematics in 1875, and studied for a year or two at the Cavendish Laboratory under Clerk Maxwell. He afterwards set up a laboratory at Pixholme, near Dorking, at the house of his father. Here he conducted researches which were the development of his work at Cambridge, and which were published in the *Philosophical Transactions* of the Royal Society in 1877 and 1879. Amongst these was an investigation of the electromagnetic rotation of polarised light carried out under Clerk Maxwell's direction. At the Dublin meeting of the British Association he gave an account of his investigation of sparking distances in air at different pressures. An elaborate research on the specific inductive capacity of solid and liquid dielectrics was published in *Phil. Trans.*, 1879. In 1880 he published "A Physical Treatise on Electricity and Magnetism," a work which is now in its third edition, and which has been published also in America and France. This book contains excellent accounts of the works of Boltzmann and others on specific inductive capacity, of terrestrial magnetism and the instruments used for measuring it, of the B.A. determination of the ohm in 1863, Prof. Adams's work on equipotential lines and lines of flow, and the researches of Spottiswoode, Moulton, and De la Rue on discharges in vacua. In 1879 and 1880 he was busily employed in experimenting on a platinum-iridium lamp. In 1881 he was appointed one of the thirty-one English delegates to the Electrical Exhibition in Paris, and in the following year he built his first large alternate-current dynamo at the Greenwich works of the Telegraph Construction and Maintenance Company. It was undoubtedly before its time, and cannot be said to have been a success, but it is of interest as being the first example of a large slow-speed dynamo. The 32 field-magnets were mounted on a rotating wheel, 8ft. 9in. in diameter, and the stationary armature coils were coupled for any desired voltage; transformers were not in existence at that time. In 1884 he published his "Practical Treatise on Electric Lighting," in which a good account of the early manufacture of glow-lamps is given. Nothing further besides a few experiments was done with his dynamo, which was protected

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by two patents, until 1884, when he designed the then largest central station for lighting Paddington station, offices, hotel, &c. The three dynamos, each weighing 45 tons, and having magnet wheels 9ft. 8in. in diameter, while not large compared with modern machines (the two large Ferranti dynamos at Deptford having armatures 13ft. in diameter), attracted great attention at the time, as, indeed, did the many ingenious devices which were employed at this station. The Paddington plant was started on April 21, 1886. The Whitehall station becoming the nucleus of the present Metropolitan Electric Supply Company, Mr. Gordon became associated with the design of several new stations. About a year later, in the autumn of 1889, he severed part of his connection with the Metropolitan Company and commenced business as a consulting engineer; his restless activity found ample scope in the tempting occupation of erecting complete central stations and distributing systems at Carlow, Larne, Bray, Sydenham, and Windsor, and his sad death occurred just at the time when, owing to the large expenditure of capital involved in such work, his business was embarrassed; and his career was cut short just when his energies were needed to pull through the difficulties which surrounded it.

Glover, Walter T.—The death of Mr. Walter T. Glover, of the well-known firm of Walter T. Glover and Co., electrical wire makers, Salford, took place in May. Mr. Glover had been out of health for several years. He was one of the few men who had the boldness to think and to say that the much-abused Electric Lighting Act of 1882 did more good than harm, inasmuch as it prevented the perpetration of a lot of crude electrical engineering. Mr. Glover was one of the first to realise the necessity for accurate tables of the resistance and weight of electrical conductors; and his tables practically held the field until the introduction of the standard wire gauge.

Hertz, Heinrich.—The death of Dr. Heinrich Hertz took place at Bonn on January 1, 1894, after a long illness. A sketch of the career of this distinguished *savant*, who was only 37 years of age, will be found on p. xliv. of the Biographical Division, at the end of this book.

Hipp, M.—On the 3rd of May there passed away, in the person of Dr. M. Hipp, a telegraph pioneer of the first rank. Dr. Hipp was born on the 28th of October, 1813, at Blaubeuren in Wurtemberg, and after a short schooling was apprenticed to a watchmaker. In 1842 he settled down at Reutlingen, and busied himself with the making of watches and instruments of precision. Electric telegraphy, however, had a great attraction for him, and, thanks to his mechanical talent, he succeeded in 1845 in constructing what was then considered an epoch-making printing telegraph; the principle of which he subsequently applied to his chronoscope chronograph and electro-chemical telegraph. The limit of his printing telegraph was 130 letters a minute, and it never came into general use, chiefly because the inventor had not the means of pushing it. In the early fifties, Dr. Hipp went to Austria at the instance of Steinheil, but the proposed appointment to the Austrian Telegraph Service fell through, it being discovered that Dr. Hipp was a member of the Reutlingen Democratic Club. In 1852, owing to Steinheil's influence, Dr. Hipp was given the appointment of superintending the erection of the Swiss Telegraphs. After the lines had been completed, and got into working order, Dr. Hipp undertook the management of the Federal Telegraph Factory, which in a short time was provided with all the necessary machines for turning out telegraph apparatus in the best style. These works soon produced more than Switzerland could absorb, and the surplus was sold to Germany, France, and Italy. In 1855 the manager of the Swiss Federal Telegraph Factory obtained the Gold Medal at the Paris Exhibition, this recognition of his labours being given him specially by Napoleon III. on account of a very handy telegraph apparatus. In this year also the Hipp relay was brought out. It was devised with a view to supply the needs

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of the Swiss Telegraph Service, but Steinheil, with characteristic modesty and disinterestedness, recognising its superiority, succeeded in making it widely known. About the same time also, Dr. Hipp brought out his so-called "Ratchet Wheel" printer, the idea of which was to render relays and local batteries unnecessary with Morse instruments. A very delicate electromagnet brought the printing lever alternately in contact with two small, sharp-toothed rapidly-rotating wheels, the power necessary for making an impression being derived from the clockwork of the apparatus. This ingenious, though delicate, apparatus never enjoyed much favour, and by 1863 it had entirely disappeared from the State telegraphs, although still used up to 1876 on the West Swiss Railways. In addition to managing the telegraph works, Dr. Hipp was ceaselessly busied with all manner of electrical devices, and with experiments on the induced "make and break" currents. In spite of the external prosperity of the Telegraph Factory, however, several difficulties arose, and finally, in 1860, the works were completely separated from the State, Dr. Hipp then founding a telegraph factory in Neuenburg. Soon after this, Dr. Hipp began to devote his attention to the daily increasing important branch of railway telegraphs, and in 1862 erected an electric signalling apparatus at the Winterthur Railway Station. After having spent several years on this branch of electric construction, Dr. Hipp turned his attention to electric clocks. Much of the valuable work that Dr. Hipp did in this and other directions has not been credited to him, owing to the fact that he wrote but few memoirs, most of which were buried in the *Proceedings of the Philosophical Societies of Bern and Neuenburg*. Telephony also owes to Dr. Hipp many noteworthy improvements, amongst which may be mentioned the Granular Microphone, one of the best of the type, the great advantage of it being that it will work almost equally well under all circumstances. On this account Dr. Hipp's Microphone was specially suitable for military purposes, and has been used in connection with the St. Gotthard fortifications. In 1873, at the Vienna Exhibition, Dr. Hipp was decorated with the order of Franz-Joseph, and in 1875 he was granted by the Zürich University the degree of Doctor, *honoris causâ*. Dr. Hipp spent the last few years of his life at Zürich.

Hofstede, J. P.—The death of M. J. P. Hofstede, the head of the Department of Posts and Telegraphs at the Hague, took place in March. The deceased represented the Netherlands at the International Telegraph Conferences held in Berlin and Paris, and was a perfect master of all detail in connection with his department.

Marié-Davy, M.—The death of M. Marié-Davy took place on July 16th at Clamecy, in the Department of Nièvre. Born in the year 1816, M. Davy lived to the ripe age of 77, and, though in later years he appears to have retired from the field of active scientific research, yet in earlier years he contributed many valuable Papers to, and took a prominent part in, the proceedings of the Académie des Sciences. His principal profession was that of an astronomer. Electricians have most cause to remember Marié-Davy on account of the mercury sulphate cell which he invented. This was his principal, if not his sole, invention in the field of electricity; but it has served a useful purpose in its time, though latterly it has been replaced by the silver chloride cell, for accurate work, and by less expensive batteries for commercial purposes. The object which Marié-Davy had in the invention of this cell was the production of a high and fairly constant electromotive force.

Phillips, Samuel Elkins.—The death of Mr. Samuel Elkins Phillips, in his 80th year, took place in May. He was associated with the late Dr. Whitehouse in the early days of the first Atlantic cable project. Later he was appointed superintendent of the Benghazi Station on the line connecting Malta and Alexandria, *viâ* Tripoli and Benghazi. On returning to England he was appointed by the Government one of the superintendents who were sent out with the Persian Gulf cable, and in this capacity was in charge of the Bushire Station.

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Phillips, Samuel Edmund.—The death, at the age of 45, of Mr. Samuel E. Phillips, of the well-known firm of Messrs. Johnson and Phillips, took place on July 22nd. When a boy, Mr. Phillips was brought into contact with telegraphy, his father being at that time engaged with Dr. Whitehouse in carrying out experimental work in connection with the first Atlantic cable. He subsequently accompanied his father in the first Malta and Alexandria cable expedition, after which he became a member of the staff which Colonel Stewart formed to go out with the Persian Gulf cable. At the end of three years' service he returned to England, and obtained an appointment on the electrical staff of Messrs. Latimer Clark, Forde and Co., leaving these gentlemen to become electrician to Mr. W. T. Henley, in whose service he remained for ten years. At Mr. Henley's works he was appointed manager of the cable department, and occasionally he accompanied some of the cable expeditions as the head of the electrical department. As an inventor, Mr. Phillips has given us a fluid insulator, which has been largely adopted in India, Egypt and other countries. In 1875 he joined Mr. W. Claude Johnson in partnership, and a small works was established at Charlton, near London This formed the nucleus of the present extensive range of factories. Mr. Phillips took the keenest interest in scientific matters generally, and to his good judgment and sound common sense may be attributed in a great measure the success of his undertakings.

Reckenzaun, Anthony.—Mr. A. Reckenzaun, whose name will be long remembered in connection with electric locomotion on land and water, died on Saturday, November 11th, of consumption, at the age of 43 years. Mr. Reckenzaun was born at Graz, in Austria, where he received a thorough technical education. He had early opportunities of gaining practical experience with constructive details in the ironworks of his father. Desirous of enlarging his knowledge, he came to England in 1872, and obtained employment with the then flourishing marine engineering firm of Messrs. Ravenhill and Miller, of London, where the most powerful engines for the British and various foreign navies were constructed. When Mr. Ravenhill retired the business was transferred to Messrs. Easton and Anderson, of Erith, whither Mr. Reckenzaun followed. In connection with the Erith ironworks he established evening classes for the benefit of the *employés*, and gave lectures during three years on "Machine Construction and Drawing" and "Steam." After visiting the Paris Exhibition of 1878 he resolved to devote himself to the study of electrical engineering, and attended Prof. Ayrton's lectures at Finsbury Technical College. In 1881, again, at the great Electrical Exhibition in Paris, he spent nearly every day for three months within the Palais d'Industrie in order to become thoroughly acquainted with all the systems then on exhibition. After his return from Paris he joined the Faure Accumulator Company, which he left, however, soon afterwards, and accepted the post of Engineer to the Electrical Power Storage Company. There he designed the first electric launch, "Electricity," driven by means of storage batteries, in 1882, and soon afterwards he made the electric tramcar which was exhibited on the West Metropolitan Tramway in March, 1883. In 1885 Mr. Reckenzaun started business on his own account for the purpose of building boats, cars, and electric motors for various purposes. The most noteworthy of the boats was the "Volta," which made the double voyage between Dover and Calais on September 13, 1886, also the more difficult voyage between London and Dover. Mr. Reckenzaun spent nearly a year in the United States, when he introduced his electric cars on several tramways, and where he built the "Magnet," the first electric launch in American waters. He was an ardent advocate of secondary batteries, and has contributed largely to our knowledge of the subject. For the last few years Mr. Reckenzaun practised as a consulting engineer, concerning himself with power distribution and accumulators. Mr. Reckenzaun was essentially an engineer, and in devoting himself as he did to the use of accumulators for motive power, it is a question whether he did not give them more consideration than they deserved.

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Smith, Oliver.—The death of Mr. Oliver Smith took place in August. The deceased was born at Great Yarmouth in 1833, and joined the Gutta Percha Company in 1851, in which year he took a part in the manufacture of the 1851 Channel cable from Dover to Calais. In 1854 he left the Gutta Percha Company to enter the service of Messrs. Glass, Elliot and Co. at Greenwich, and from 1861 to 1864 assisted in laying cables from Malta to Alexandria, from Ireland to Wales, and from Sardinia to Sicily. He was engaged on the first Atlantic cable of 1858 on the "Agamemnon," and when the "Great Eastern" was chartered to take out the new Atlantic cable in 1865 he was in charge of the electrical department on board at Sheerness, during the shipping of the cable. He also accompanied the expedition of that year, as also those of the Atlantic cables of 1866 and 1869, as electrical assistant to his brother, the late Mr. Willoughby Smith. From this time to the end of his life Mr. Smith was in the service of the Telegraph Construction and Maintenance Company, during the greater part of which time he was engaged as electrician at Enderby's Wharf, Greenwich, although occasionally assisting in cable expeditions.

Tyndall, John.—The death of Prof. Tyndall took place on December 4th. Prof. Tyndall was one of those men to whom it was given, not so much to be himself pioneer as to diffuse into others the spirit of pioneering, not so much to investigate as to make known the investigations of others in a spirit of sympathetic enthusiasm that warmed and infected his hearers. Possessed of a fluent and impressive delivery, rising at times into real oratorical power, his lectures attained a charm of style unique and inimitable. Ease and skill in experimentation before an audience—an art only to be acquired as the result of skill practised in the laboratory—he probably learned more from Faraday than from any other, except, perhaps, Bunsen. Even in his less-convincing discourse, when he left the exposition of science for the speculations of the philosopher, his peculiar gifts of manner carried his hearers irresistibly along. Born near Carlow, in 1820, the son of a member of the Irish constabulary, he had few advantages in the way of early training beyond a sound knowledge of geometry, and a schooling that lasted until he was nearly 19. He entered the Ordnance Survey as a civil assistant in 1839, and was occupied in this work until 1843. Then, for three years, he was employed in railway surveying in various parts of England, only to find that his passion for science would not let him settle to the life of surveyor. So he accepted a post as assistant teacher at Queenwood College in Hampshire, and was by that fortunate circumstance brought into fellowship with the then rising young chemist, Edward Frankland. In 1848, these two young men repaired to Marburg to study under Bunsen, Tyndall going on later to Berlin to work under Magnus at physics. He translated Clausius's thesis on the moving force of heat, and subsequently that of Helmholtz on the conservation of force, which was pointed out to him by his friend Du Bois Reymond. Whilst in Germany he began those investigations into diamagnetism, and the relations of magnetism to crystallography, which will ever be associated with his name. It was his work on these two kindred topics that brought him first into notice. He was, on his return to England, invited to lecture at the Royal Institution, where Faraday had for twenty years been actively at work. The lecture was given in February, 1853, and in May of the same year the post of Professor of Natural Philosophy was created for him. He devoted much time during the succeeding years to research, and from magnetism passed on to the subject of the radiation of heat, upon which subject he published—mainly in the *Philosophical Transactions* of the Royal Society—a number of memoirs. The substance of these was afterwards reprinted in a separate volume. His more popular work, "Heat a Mode of Motion," was published in 1863, and was followed by the volumes of lectures "On Sound" and "On Light." This latter was the substance of his famous lectures delivered in America in 1872. On electrical subjects, beyond the diamagnetic researches, he published little, his "Notes on Electricity" being mainly historical. His other topics of research were: the motion and structure of

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glaciers, the spread of dust and germs in the atmosphere, and the effect of mist and fog on sound. In his youth the disciple, and in his middle age the intimate friend, of Carlyle, he also owed much to the influence of Emerson and to that of Goethe. His lectures contain frequent references to these his masters in literature; but his style was not modelled on that of any of them. The vehemence with which at times he spoke and wrote was indeed but one result of the passionate sincerity of soul and of the restless energy that burned within him. He made the whole world his debtor by his masterly expositions of modern science.

Van Rysselberghe, F.—The death of the eminent Belgian electrician, M. Van Rysselberghe, took place in February. M. Van Rysselberghe was born at Ghent on August 25, 1846. At the time of his decease he was consulting engineer to the Telegraph Department of the Belgian Government; Professor of Electrotechnics at the University of Ghent; Chevalier of the Legion of Honour and of the Order of Leopold. Having mainly completed his education by his own exertions, M. Van Rysselberghe was, in 1865, appointed Professor of Nautical Astronomy at Ostend, where he invented the Maréeographe, for recording the rise and the fall of the tide, and the Météorographe, for registering atmospheric changes. Having acted as hydrographical engineer, charged with preparing a chart of the Scheldt, he was in 1887 attached, as meteorologist, to the Royal Observatory at Brussels, and entrusted with editing the *Bulletin* of the Observatory. It was at this period of his career that he invented his Telemétéorograph, which was awarded a gold medal at the International Electrical Exhibition of Paris in 1881. Taking part in the Congress of Electricians in the same year, he was made Chevalier of the Legion of Honour. In 1880 M. Van Rysselberghe began the experiments in simultaneous telephony and telegraphy, with which his name is identified, on the wire running between the Brussels Observatory and the Meteorological Station at Ostend. In 1884, on giving the Belgian Government free use of his invention M. Van Rysselberghe was appointed consulting engineer to the Telegraph Department of the Belgian Government, and was also made Chevalier of the Order of Leopold. Subsequently, in conjunction with M. Charles Mourlon, he was occupied in pushing his system of simultaneous telephony and telegraphy, and in devising an hydro-electric scheme for the town of Antwerp.

Weaver, Henry.—The death of Mr. H. Weaver occurred at Folkestone on Wednesday, September 20th, from heart disease. Born at Shrewsbury on May 5, 1825, Mr. Weaver entered the Electric Telegraph Company in May, 1846, and had charge of various stations in England till 1853. In connection with this Company two submarine telegraph cables were laid between Lowestoft and the Hague, and subsequently two more between Lowestoft and Zand Voort, Holland. This undertaking was managed by Mr. Weaver until 1859, when the Dutch ends of the cables were transferred to the Dutch Government. Upon his return to London, in 1859, he became metropolitan superintendent for the Electric Telegraph Company, and manager of the International Telegraph Company in London, which position he occupied till 1864, when he was appointed secretary to the Electric and International Telegraph Company, and held that position till 1870, when the telegraphs were transferred to the Government. The whole of the negotiations for the purchase by the State of the lines, cables, and business of the companies represented by him were under his control, he being appointed sole arbitrator. After the transfer of the inland telegraphs to the State, Mr. Weaver took the management of the Anglo-American Telegraph and the Atlantic Telegraph Companies, which position he held since January 1, 1870. In addition to being managing director of the Anglo-American Company, he was also director of the Indo-European Telegraph Company, director of the West India and Panama Telegraph Company, and the Western Union Telegraph Company. Mr. Weaver originated the "word" system of counting and charging messages, and introduced it on the Atlantic cables on May 1, 1872.

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THE CHARTERED INSTITUTE OF PATENT AGENTS

(FOUNDED, 1882; INCORPORATED BY ROYAL CHARTER, 1891),

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H. HOWGRAVE GRAHAM, *Secretary.*

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Allison, C. A., 52, Chancery-lane, W.C.
Barker, G., 77, Colmore-row, Birmingham.
Beck, W. H., 115, Cannon-street, E.C.
Birkbeck, H., 34, Southampton-bldgs.
Boult, A. J., 323, High Holborn, W.C.
Brewer, E. G., 33, Chancery-lane, W.C.
Brewster, E. H. G., 12, Delahay-st., S.W.
Brookes, A. G., 55, Chancery-lane, W.C.
Brougham, F. J., 46, Lincoln's Inn-fields.
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Carpmael, A., 24, Southampton-buildings, W.C.
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Carpmael, W., 24, Southampton-buildings, W.C.
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Chapman, J. C., 70, Chancery-lane, W.C.
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Cheetham, H., 18, St. Ann's-street, Manchester.
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Davies, C. A., 4, St. Ann's-sq., Manchester.
Davies, G., 4, St. Ann's-sq., Manchester.
Day, C. A., 321, High Holborn, W.C.
Drury, R. F., 24, George-st., Sheffield.
Dutton, E. K., 5, John Dalton-street, Manchester.
Fairweather, W., 62, St. Vincent-street, Glasgow.
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Fell, J. C., 1, Queen Victoria-street, E.C.
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Hastie, A. H., 65, Lincoln's Inn-fields, W.C.
Heys, W. E., 70, Market-st., Manchester.
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Imray, J., 28, Southampton-bldgs., W.C.
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Johnson, James Y., 47, Lincoln's Inn-fields, W.C.
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Justice, P. M., 56, Chancery-lane, W.C.
King, J. T., 4, Clayton-sq., Liverpool.
Lake, H. H., 45, Southampton-buildings.
Lake, W. R., 45, Southampton-buildings.
Leigh, H. H., 22, Southampton-buildings.
Livsey, P. J., 5, Market-st., Manchester.
Lorrain, J. G., Norfolk House, Norfolk-street, W.C.
Mewburn, J. C., 55 and 56, Chancery-lane, W.C.
Newton, A. V., 6, Bream's-bldgs., W.C.
Newton, H. E., 6, Bream's-bldgs., W.C.
Newton, P. A., 6, Bream's-bldgs., W.C.
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Popplewell, W. W., 32, Southampton-buildings, W.C.
Powell, A. J., 35, Temple-row, Birm.
Rapson, F. J., Hutton, Brentwood, Essex.
Royston, E. R., 15, Water-st., Liverpool
Shaw, G., 35, Temple-row, Birmingham.
Skerrelk, R., 35, Temple-row, Birm.
Spence, W.
Thomson, W. R. M., 96, Buchanan-street, Glasgow.
Wade, H., 323, High Holborn, W.C.
Watkins, S., Prince's Chambers, Prince's-square, Wolverhampton.
Watts, N., Bristol Bank-bldgs., Bristol.
Waugh, J., Sunbridge-chbrs, Bradford.
Whiteman, W. T., 7, Staple Inn, W.C.
Willcox, B., 47, Lincoln's Inn-fields, W.C.
Wise, W. Lloyd, 46, Lincoln's Inn-fields, W.C.

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PATENTS, DESIGNS, AND TRADE MARKS.

THE following practical information concerning the procedure and average costs of obtaining Letters Patent for Inventions, and the Registration of Trade Marks and Designs, has been compiled for this Directory by Mr. J. C. CHAPMAN, Assoc. Mem. Inst. C.E., Mem. Inst. M.E., Fel. Chartered Inst. Patent Agents, from whom all information regarding Patents for Inventions may be obtained.

BRITISH LETTERS PATENT.

(Covering Great Britain, Ireland, and the Isle of Man.)

The Acts in force are cited collectively as the Patents, Designs, and Trade Marks Acts, 1883 to 1888. The principal Act, 1883 (46 and 47 Vict., Ch. 57), is "An Act to Amend and Consolidate the Law relating to Patents for Inventions, Registration of Designs, and of Trade Marks" (25th August, 1883).

The Amendment Act, 1885 (48 and 49 Vict., Ch. 63) deals with applications for Patents by several persons jointly; it also grants extension of time for leaving complete specifications, and provides that incompleted applications shall never be open to inspection or published.

The Amendment Act, 1886 (49 and 50 Vict., Ch. 37), modifies the regulations as to drawings, and extends protection to exhibits at foreign international exhibitions.

The Amendment Act, 1888 (51 and 52 Vict., Ch. 50), provides for a Register of Patent Agents being kept, defines duties of Comptroller in reference to examiners' reports, contains numerous amendments as to applications, oppositions, and other matters, and defines the essential particulars of a Trade Mark.

GENERAL.

The British Patent right covers the United Kingdom of Great Britain, Ireland, and the Isle of Man.

Every Patent is granted for 14 years, and is numbered and dated as of the day of application. This term may be prolonged by order of the Privy Council under certain conditions appearing in evidence.

The duty paid on application with the complete specification covers the first term of 4 years.

The remaining 10 years may be covered by annual fees, viz. :—

Before the expiration of the 4th year from the date of the Patent in respect of the 5th year, £5, and so on, increasing £1 annually up to £14 in respect of the 14th year, at the expiration of which the Patent lapses. Or the Patentee may pay the whole or any portion of the aggregate of such prescribed annual fees in advance.

The dates of payment may at the Comptroller's discretion be extended for 1, 2, or 3 months on payment of fees of £1, £3, and £5 respectively. No further extension can be allowed beyond three months.

Letters Patent are granted (1) to the true and first inventor or inventors; (2) to the first importer or importers, or their agent; or (3) to several persons jointly, one or more of whom is or are the first inventor or inventors.

Thus, a financier or a company can obtain security at once by joining an inventor in the application.

For a valid Patent the subject-matter must be referable to some *manner of manufacture*, and must, in addition, be new and useful, and display some amount

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of invention. It is advisable for an applicant to have a search made as to novelty before settling his complete specification and claims.

No official search is made, and the grant of a Patent does not guarantee its validity. Searches as to novelty, title, or record may be made in the records of the Patent Office, where all specifications of prior Patents and indexes ("Alphabetical" and "Subject Matter"), supplemented by abridgments of specifications, are kept. A Patent holds good against the Crown. No working conditions exist, nor is importation forbidden.

A Register of Patents is kept, and therein the names and addresses of patentees, registered assignments, and transmissions (under agreement or otherwise), licences, amendments, extensions, and revocations, and all other matter affecting the validity or the proprietorship of Patents, are recorded.

Compulsory licences may be ordered to be granted by the Board of Trade if default be made by the patentee to grant licences on reasonable terms, or the reasonable requirements of the public cannot be supplied, or any person is prevented from working or using to the best advantage an invention of which he is possessed.

PENALTIES.

The following is the complete text of Sections 105 and 106 of the Patents, Designs, and Trade Marks Act, 1883.

105. (1) Any person who represents that any article sold by him is a patented article when no Patent has been granted for the same, or describes any design or trade mark applied to any article sold by him as registered which is not so, shall be liable for every offence on summary conviction to a fine not exceeding five pounds.

(2) A person shall be deemed, for the purposes of this enactment, to represent that an article is patented or a design or a Trade Mark is registered, if he sells the article with the word "Patent," "Patented," "Registered," or any word or words expressing or implying that a Patent or Registration has been obtained for the article stamped, engraved, or impressed on, or otherwise applied to, the article.

106. Any person who, without the authority of Her Majesty, or any of the Royal Family, or of any Government Department, assumes or uses in connection with any trade, business, calling, or profession, the Royal arms, or arms so nearly resembling the same as to be calculated to deceive, in such a manner as to be calculated to lead other persons to believe that he is carrying on his trade, business, calling, or profession by or under such authority as aforesaid, shall be liable on summary conviction to a fine not exceeding twenty pounds.

PROCEDURE.

A Patent may be applied for in two ways :—

(1) By application with PROVISIONAL SPECIFICATION. This must state the nature of the invention, and secures protection for 9 months (extensible to 10), before the expiry of which a Complete Specification must be filed. This will carry on the Patent for 14 years from date of application, subject to the above periodic payments.

(2) By application with COMPLETE SPECIFICATION, in the first instance, which secures protection for 14 years, subject to the above annual payments.

In either case immediate protection is obtained, and the invention may be published or exercised before the actual grant, at the applicant's risk; no true protection is acquired by provisional protection except as regards priority of date, for no action for infringement can be entered before the Patent is granted.

The application must be in accordance with the prescribed rules, and be accompanied by a declaration and petition. The authorisation of a respectable Patent agent to deal with all matters affecting the Patent is very advisable, as much time is thus saved.

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The Publisher would esteem it a favour if persons using this Directory will make reference thereto in their Correspondence with Manufacturers, &c.

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The 9 or 10 months secured by provisional protection enables an inventor to experiment and develop his invention, and also to apply for foreign Patents before completing his home Patent.

The provisional specification is the foundation of a Patent, and should therefore be most skilfully drawn, as the subsequent complete specification and Patent are controlled by it, no additions being valid which extend the scope of the invention described in the Provisional.

The complete specification, whether left on application or subsequently, must particularly describe and ascertain the nature of the invention, and in what manner it is to be carried into useful effect, and be accompanied by drawings if required. The description must be such as to enable any person of ordinary skill in the art to produce the same result from the directions contained in the specification and drawings. No Patent can cover more than one invention, though modifications and subordinate claims are allowed. The specification must conclude with a distinct statement of what is claimed as the invention.

The claims are most important; on them the whole value of the Patent depends.

If too much be claimed the whole is invalidated until amended; if too little, it may be valueless.

For these reasons it is most indiscreet, especially in the case of a valuable invention, for anyone to attempt to settle claims who is not well acquainted with the laws and most recent judicial decisions in connection with the subject, and the employment of a competent Patent agent is again advised.

Every application is referred to an official examiner, who reports to the Comptroller.

The examiner's report is private.

In case of an adverse report the Comptroller may, after hearing the applicant or his agent, require the papers to be amended.

The applicant may appeal from the Comptroller's decision to the Law Officer, whose decision is final.

If a complete specification is not filed within 10 months of the provisional date the application will be deemed to be abandoned, and if so abandoned is never published.

Specifications, whether provisional or complete, if in proper form and not requiring amendment, may be accepted in from 4 to 6 weeks from date of filing.

Unless a complete specification is accepted within 12 months from the date of application, then at the expiration of such 12 months (save in the case of an appeal having been lodged against the Comptroller's refusal to accept), the application shall become void. In case of such appeal the 12 months may be extended to 15 months.

When a Complete Specification has been accepted, it is advertised as such, and any person can examine it at the Patent Office on payment of a fee.

During the 2 months following the date of the advertisement of the acceptance of a complete specification, any person can oppose it on the following grounds:—

(1) That the applicant obtained the invention fraudulently.

(2) That the invention has been patented in this country on an application of prior date.

(3) That applicant's complete specification describes or claims an invention other than that described in the provisional specification, and that such other invention forms the subject of an application made by the opponent in the interval between the leaving of the provisional specification and the leaving of the complete specification; but on no other grounds.

If it is unopposed, or if opposition be decided in favour of the applicant, the Patent is sealed at the expiration of the 2 months.

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In cases of opposition, statutory declarations may be filed by both sides, and the case is heard and decided by the Comptroller.

Either side can appeal from his decision to the Law Officer, whose fiat is final.

A Patent may be revoked on certain grounds.

The specification, with drawings (if any), is officially printed and published 21 days after acceptance of complete specification. The cost of all officially printed specifications is 8d. each.

The following are fair average charges for obtaining Letters Patent:—

PROVISIONAL PROTECTION.

Instructions for application with provisional specification, drawing title, declaration, and provisional specification, and preparing fair copies, paid fee on application, £1; obtaining provisional protection, agency, letters, postages from £3 3s. to £5 5s.

COMPLETE SPECIFICATION AND PATENT.

Instructions for complete specification, drawing same, and settling claims and preparing fair copies of same; paid stamp duty, £3; obtaining allowance of specification and Letters Patent, agency, letters, postages from £8 8s. to £10 10s.

WHEN COMPLETE SPECIFICATION IS LODGED IN FIRST INSTANCE.

Taking instructions for complete specification, drawing title and declaration and complete specification, and settling claims and preparing fair copies of same; paid stamp duty, £4; obtaining allowance of specification and Letters Patent; agency, letters, postages from £10 10s. to £12 12s.

Drawings may in some cases be included, but are usually charged for extra, according to the requirements of the invention, and the draughtsmen's time.

The above are the costs of obtaining an unopposed Patent for four years, and apply to all average cases.

In cases of appeal or opposition extra costs will arise, of which an approximate estimate can usually be given.

It is an essential requisite for a valid Patent that a full disclosure of the whole invention, and the best means of practically performing or effecting it within the inventor's knowledge, be set forth. Any ambiguity, omission, or concealment of essential features will invalidate the Patent.

COLONIAL AND FOREIGN PATENTS.

The order or sequence in which colonial and foreign Patents should be applied for, especially when a British application has been made, is most important, because the term of grant varies in most countries, and it is desirable to obtain the longest term for any Patent; and because in all foreign countries (except Germany and Mexico) Patent rights expire at the same time as prior Patents of the shortest terms granted obtained in other countries for the same invention.

By the International Convention, of which Belgium, Brazil, Curaçoa and Surinam, France, Great Britain, Guatemala, Italy, Netherlands, East Indian Colonies of the Netherlands, Norway, Portugal, San Domingo, Servia, Spain, Sweden, Switzerland, Tunis, United States of America, constitute a Union, the following provision is made by Article IV.:

"Any person who has duly applied for a Patent, Industrial Design or Model, or Trade Mark, in one of the contracting States, shall enjoy, as regards registration in the other States, and reserving the rights of third parties, a right of priority during the periods hereinafter stated. Consequently, subsequent registration in any of the other States of the Union before the expiry of these periods shall not be invalidated through any acts accomplished in the interval, either, for instance, by another registration, by publication of the Invention, or by the working of it by a third party, by the sale of copies of the Design or Model, or by the use of the Trade Mark.

"The above-mentioned terms of priority shall be six months for Patents, and three months for Industrial Designs and Models and Trade Marks.

"A month longer is allowed for countries beyond sea."

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The 9 or 10 months secured by provisional protection enables an inventor to experiment and develop his invention, and also to apply for foreign Patents before completing his home Patent.

The provisional specification is the foundation of a Patent, and should therefore be most skilfully drawn, as the subsequent complete specification and Patent are controlled by it, no additions being valid which extend the scope of the invention described in the Provisional.

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(1) That the applicant obtained the invention fraudulently.

(2) That the invention has been patented in this country on an application of prior date.

(3) That applicant's complete specification describes or claims an invention other than that described in the provisional specification, and that such other invention forms the subject of an application made by the opponent in the interval between the leaving of the provisional specification and the leaving of the complete specification; but on no other grounds.

If it is unopposed, or if opposition be decided in favour of the applicant, the Patent is sealed at the expiration of the 2 months.

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FOREIGN AND COLONIAL PATENTS FOR INVENTIONS.

Countries.	Term of Grant.	How Maintained.	Patents must be worked as follows :—	Approximate Average Cost.	Term Covered by Quotation.
Argentine Republic ..	5, 10, 15 years ...	Fees on application	Within 2 years of date of issue	£40, £50, £80 ...	5, 10, 15 years.
¶ Austria (alone) ...	15 years	Annual tax	Within 1 year from date of grant; working not to be interrupted for 2 years at a time.	£10	1 year.
¶ Austria-Hungary .. (combined)	15 years	Annual tax, increasing after first 5 years.		£11 to £15	1 year.
¶*Belgium	20 years	Annual increasing tax ...	1 year from first working elsewhere; if applied for after working elsewhere, 1 year from date of patent.	£6 to £9	1 year.
¶*Brazil	15 years	Ditto	3 years from date of patent; not to be interrupted more than 1 year at a time.	£40 to £50	1 year.
¶ Canada	15 years	Full fees on application, or by taxes before end of 5th and 10th years.	2 years from date of patent, and working not to be discontinued.	£14 to £20	5 years.
¶ Cape of Good Hope	14 years	By taxes before end of 3rd and 7th years.	No conditions	£25 to £30	3 years.
Ceylon	14 years	By payment of all fees on application or before end of 4th year and *then annually.*	No conditions	£25 to £30	14 years.
Chili	Fixed by Government.	None	Ditto	£100.	
¶ Denmark	From 3 to 15 years. Term fixed by Government.	Fees on application	1 year from date; not to be interrupted more than 1 year at a time.	£9 to £16	Full term granted.
¶*France	15 years	Annual tax	2 years from date of issue; not to be interrupted 2 years at a time.	£10 to £15	1 year.
Germany	15 years	Annual increasing tax, 3 months' grace allowed.	3 years from publication of grant...	£12 to £20	1 year.
Do. "Utility Model"	3 to 6 years	Fee end of 3rd year	No conditions	£4 and £8	3 and 6 years.
*Great Britain	14 years	*See* pp. 77-80	None. *See* pp. 77-80.....	.....	*See* pp. 77-80

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Countries.	Term of Grant.	How Maintained.	Patents must be worked as follows :—	Approximate Average Cost.	Term Covered by Quotation.
Hong Kong	Term fixed by Governor, same as English patent.	Fees on application	None	£30 to £40	
¶ Hungary (alone)	15 years	Annual taxes	1 year from grant	£10	1 year.
¶ India	14 years	Tax to be paid before expiration of 4th and each succeeding year.	None	£18 to £25	4 years.
¶*Italy	Any term not exceeding 15 years.	A proportional and annual tax increasing triennially.	Under 6 years' patent, 1 year from date of grant; over 6 years, 2 years from date of grant; not to be interrupted more than 2 years at a time.	£12 to £15 (incl. proportional tax) £18 to £20 do. £21 to £25 do.	1 year. 6 years 15 years.
Japan (New Law 1888)	5, 10, and 15 years	Fees on application for term.	Within 3 years, not to be discontinued for any consecutive 3 years.	£20 £6 to £12	5 years. 1 year.
Luxembourg	15 years	Annual and progressive tax.	May be revoked unless worked within 3 years from date of patent	£50 to £60.	
Mexico	20 years	Fees on application	Within 5 years from date of patent	£25 to £30.	
¶ Natal	14 years	Stamp duties before end of 3rd and 7th years from date.	No conditions		
New South Wales	14 years	Fees on application	None	£15 to £20	14 years.
¶ New Zealand	14 years	Tax before end of 5th year	Within 2 years from date	£15 to £20	5 years.
¶ Newfoundland	14 years	Fees on application	Ditto	£35 to £40	14 years.
*Norway	15 years	Annual progressive tax ... [and 7th years.	3 years from date; not to be interrupted for more than 1 year.	£10 to £15	1 year.
¶ Orange Free State	14 years	Tax before expiry of 3rd	Compulsory licenses can be enforced	£35 to £45	3 years.
¶*Portugal	Any term not exceeding 15 years.	Fees on application	2 years from date; not to cease working 2 years subsequently.	£30 to £50	Term granted.
Queensland	14 years	Taxes before 4th and 8th years, or by annual payments from 4th year.	No conditions	£15 to £20	4 years.
¶ Russia	3, 5, or 10 years...	Fees on application	Within a quarter of the term granted.	£30 £50 £80	3 years. 5 years. 10 years.

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FOREIGN AND COLONIAL PATENTS FOR INVENTIONS—(*Continued*).

Countries.	Term of Grant.	How Maintained.	Patents must be worked as follows :—	Approximate Average Cost.	Term Covered by Quotation.
¶ South Australia ...	14 years	Taxes before 3rd and 7th years.	Patent may be revoked if not worked within 3 years from date of patent.	£16 to £21	3 years.
¶*Spain	10 years, if a foreign patent has been applied for previously; if not so, 20 years.	Annual increasing tax ...	2 years from date; not to be interrupted for more than 1 year and 1 day.	£14 to £18	1 year.
¶ Straits Settlements	14 years	Fees on application	None	£25 to £35	14 years.
¶ Sweden	15 years	Annual tax increasing every 5 years, payable in advance.	3 years from date of patent; not to be interrupted more than 1 year at a time.	£12 to £16	1 year.
*Switzerland.....	15 years	Annual increasing tax ...	3 years from date of application ...	£10 to £12	1 year.
¶ Tasmania.....	14 years	Stamp duties before end of 3rd and 7th years.	Compulsory licenses can be enforced	£16 to £20	3 years.
¶*Transvaal	14 years	Tax before expiry of 3rd and 7th years.	Compulsory licenses can be enforced	£35 to £45	3 years.
¶ Turkey	5, 10, or 15 years	Annual tax	2 years from date of issue; not to be interrupted more than 2 consecutive years.	£25	1 year
¶*U.S. America	17 years	Fees on application	None	£18 to £26	17 years.
¶ Victoria	14 years	Stamp duties before end of 3rd and 7th years.	None	£15 to £20	3 years.
¶ Western Australia	14 years	Fees on application for Letters of Registration tax before end of 4th and 7th year for letters' patent.	None	Letters of Registration, £25 to £35.	Term granted.
				Patent, £25	4 years.

* These countries are members of the International Convention.
¶ The Term of Grant in these countries is subject to that of existing foreign patents.

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REGISTRATION OF DESIGNS.

Copyright of a design may be granted to or on behalf of anyone claiming to be the proprietor of a new or original design not previously published in the United Kingdom, whether it be applicable for the pattern, shape, or configuration or ornament of any article of manufacture (except sculpture, which is specially provided for by the Sculpture Copyright Act of 1814).

Copyright in designs does not cover any motions or mechanical arrangements, as is generally supposed. It is important to remember that the *design* is for the shape, pattern, or configuration, and is quite *extrinsic* to the article of manufacture.

The duration of copyright is five years from date of registration.

An application must state the nature of the design and the class or classes of goods for which it is to be registered. The protection afforded to a registered design is restricted to the particular class or classes of goods in which the design is registered. The same design may be registered in more than one class.

Copyright of designs can be assigned.

Under certain conditions immediate registration can be secured.

A design is not open to public inspection during the term of its copyright.

An official search is always made on each application.

Prior to application an official search may be made by the Comptroller on request, who will report on the identity or similarity of proposed design to prior registrations.

All registered designs must be so marked in accordance with Rule 32 otherwise copyright is nullified.

The average charges for application and registration, inclusive of fees, &c., are :—

In classes 1 to 12, £2 2s. for the first, and £1 11s. 6d. for each subsequent application.

In classes 13 and 14, 10s. to 15s. for the first, and 7s. to 10s. for each subsequent application.

For search and report by Comptroller, under Section 53, £1 1s.

Owing to the intricacies of procedure, it is in all cases advisable to employ an experienced agent.

REGISTRATION OF TRADE MARKS.

(BRITISH.)

The rules, regulations, conditions, restrictions, &c., in connection with this department are stringent and complicated ; great care and experience are required in complying with them.

Old Marks are those used before August 13, 1875.

New Marks are those adopted since that date.

(1) A new Mark must consist of or contain at least one of the following essentials :—

(*a*) A name of an individual or firm printed, impressed, or woven in some particular and distinctive manner ; or

(*b*) A written signature or copy of a written signature of the individual or firm applying for registration thereof as a Trade Mark ; or

(*c*) A distinctive device, mark, brand, heading, label, or ticket ; or

(*d*) An invented word or invented words ; or

(*e*) A word or words having no reference to the character or quality of the goods, and not being a geographical name.

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(2) There may be added to any one or more of the essential particulars mentioned in this section any letters, words, or figures, or combination of letters, words or figures, or of any of them, but the applicant for registration of any such additional matter must state in his application the essential particulars of the Trade Mark, and must disclaim in his application any right to the exclusive use of the added matter, and a copy of the statement and disclaimer shall be entered on the register.

(3) Provided as follows:—

(i.) A person need not under this section disclaim his own name or the foreign equivalent thereof, or his place of business, but no entry of any such name shall affect the right of any owner of the same name to use that name or the foreign equivalent thereof;

(ii.) Any special and distinctive word or words, letter, figure, or combination of letters or figures, or of letters and figures used as a Trade Mark before the 13th day of August, 1875, may be registered as a Trade Mark under this part of this Act.

RESTRICTIONS ON REGISTRATION.

Ornamental or coloured groundwork, such as tartans or checks, cannot be claimed as part of a Mark unless such groundwork be included within the Mark by some border or lines.

The words "Registered," "Registered Design," "Copyright," "Entered at Stationers' Hall," "To counterfeit this is Forgery," will not be registered under the Acts, and should not, therefore, appear upon the Representations of Trade Marks forming part of an application.

The following will not be registered as Trade Marks, or as prominent parts of Trade Marks, unless the Marks have been used before 13th August, 1875:—

The Royal Arms, or arms so nearly resembling them as to be calculated to deceive.

Representations of Her Majesty the Queen, or of any member of the Royal Family.

Representations of the Royal Crown.

The National Arms or Flags of Great Britain.

Proper names.

Names in the possessive case associated with the goods.

When there appears on the face of a Trade Mark an indication of the goods to which the Mark is applied, the claim for its registration must be in respect of *those goods only.*

All new Marks must include one or more of the above essential particulars.

Trade Marks are granted to any person or firm.

A series of Marks can be registered under certain conditions.

An official search is made of a rigorous description in connection with formal applications only.

The term acquired by Registration is unlimited, subject only to a small pay ment before the end of the 14th, and each succeeding 14th year.

Registration covers the United Kingdom, Ireland, and the Isle of Man.

A Trade Mark may be assigned.

The charges are usually from £2 2s. upon application for registration, and £1 1s. on acceptance of the Mark, or £3 3s. to £4 4s. for complete registration.

For registration of a series of Marks special charges for specific cases are made.

For a search the charge varies from 10s. 6d. to £1 1s. for each class searched.

A wood block or electro must be furnished not more than two inches in depth or width, otherwise a small extra charge is incurred.

Owing to the great difficulty at present of obtaining registration of Trade Marks, the advice of an experienced agent on specific cases is advisable. In any case the procedure is tedious and troublesome, and after acceptance a Mark is advertised

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in the official *Trade Marks Journal*, during the first month of which (extensible to three months at the Comptroller's discretion) it may be opposed. The procedure is then analogous to that of Patent cases as above set forth.

PATENT AGENTS.

The Chartered Institute of Patent Agents was founded in 1882, and incorporated by Royal Charter, August 11th, 1891, and its offices are at 19, Southampton Buildings, W.C. A list of its Fellows will be found on a subsequent page; each Fellow is entitled to call himself "Chartered Patent Agent," or add after his name the letters "C.P.A." A Register of Patent Agents has been inaugurated in accordance with the Act of 1888; but it is to be understood that a "registered Patent Agent" is not by any means necessarily a "*Chartered Patent Agent*"—the rules for qualification of the latter being very strict.

MERCHANDISE MARKS ACT, 1887.

50 & 51 Vict., ch. 28.

This Act should be carefully considered by all persons who are in any way connected with manufactures or commerce.

The Act repeals the Act of 1862, and its object is to consolidate and amend the law relating to the fraudulent marking of merchandise, and to prevent the improper introduction in the United Kingdom of goods manufactured abroad. Trade descriptions as well as trade marks are also included within its scope.

Attention is called to the fact that the new Act is a Penal Act, and that every person guilty of an offence against it (sec. 2, sub-sec. 3) is liable to imprisonment, with or without hard labour, for a term not exceeding 2 years, or to a fine, or to both imprisonment and fine, and to forfeit every article by which such offence has been committed.

No prosecution for any offence can be commenced after the expiry of 3 years from the commission of such offence, or 1 year after the discovery thereof by the prosecutor, whichever expiration first happens (sec. 15).

PATENTS, DESIGNS, & TRADE MARKS ACTS,

1883 to 1888.

MERCHANDISE MARKS ACT, 1887.

Advice (based on many years' practical experience) given under the above.

Letters Patent for Inventions secured, and Trade Marks, Labels, and Designs registered at home and abroad.

Specifications for Patents and Trade Marks drawn or revised and settled.

Applications for Patents taken up after the grant of Provisional Protection, or at any stage.

Oppositions to the grant of Letters Patent conducted or defended.

Scientific evidence and cases prepared for submission to Counsel.

Amendments and Alterations prepared and executed.

Advice as to Assignments of and Licenses for the use of Inventions.

Reports and opinions given on all Mechanical Subjects, and on Patent Law.

Searches made as to previous Patents and Trade Marks; Opinions and Reports thereon.

Illustrative Diagrams. Tracings prepared. **Trade Marks designed.** The necessary Drawings prepared to accompany all applications for Registration.

Manufacturers and Traders advised on all matters affecting the Registration of Trade Marks or Designs and the Merchandise Marks Acts.

Expert evidence given in Patent or Mechanical cases.

Experienced and reliable Agents in all countries where Patent Laws exist.

No charge for preliminary information to a reasonable extent. Full information as to Procedure Terms, &c., on application to—

J. C. CHAPMAN,

(Assoc. M. Inst. C.E., M. Inst. M.E., Fellow of the Chartered Institute of Patent Agents,)

70, CHANCERY LANE, LONDON, W.C.

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This "Digest" is specially prepared for "The Electrician" Electrical Trades' Directory and Handbook, is revised to date, and is copyright.
The "Digest" is published separately, price 2/6 (with additional matter).

DIGEST OF THE LAW OF ELECTRIC LIGHTING.

By A. C. CURTIS HAYWARD, B.A., Solicitor, Associate of the Institution of Electrical Engineers.

Introductory.

ELECTRIC Lighting is governed by two Acts of Parliament known as the Electric Lighting Acts,* 1882 and 1888, which apply to the whole United Kingdom. The former incorporates portions of the Gasworks Clauses Acts, 1847 and 1871, the Lands Clauses Acts, 1845, 1860, and 1869, and the Telegraph Act, 1878. The Electric Lighting (Scotland) Act, 1890,† merely amends the Act of 1882, as regards the definition of Local Authorities in Scotland.

The other documents to be referred to all emanate from the Board of Trade. These are (1) the Rules made under (1882) § 5,‡ with respect to applications for Licenses and Provisional Orders, &c., as amended in August, 1890; (2) the Regulations made under (1884) § 4, for the protection of public safety and of the lines and works of the Postmaster-General, and of other electric lines and works; (3) the Model Form for Provisional Orders; (4) the Regulations issued under each Provisional Order for securing the safety of the public, and for ensuring a proper and sufficient supply of electrical energy.

The Model Order fills in details to the outline sketched by the Acts, and as the Board of Trade require its provisions to be inserted in all Provisional Orders and Licenses, it must be treated for practical purposes as a part of the General Law of Electric Lighting. This Model Order has undergone various changes since its first issue, and now exists in four forms, viz.: No. 1, applicable to an undertaking by a Local Authority; No. 2, by a Company or person; and Nos. 3 and 4, special forms applicable to undertakings by Companies and Local Authorities respectively within the County of London.‖ There is also a Model Eorm for Licenses. The Model Order which will be usually quoted is the No. 2 Form issued for the Session 1892 as applicable to "Undertakers being a Company or person," and the chief points in which it differs from the companion Form No. 1, relating to "Undertakers being a Local Authority," will be recorded either where they occur, or in Part II., Chapter V. A.

The Law will here be dealt with in two parts:—

I. Preliminary. Treating of the manner in which persons desirous of supplying electricity must set to work.

II. Treating of their rights and obligations after obtaining Parliamentary powers.

* 45 & 46 Vict., cap. 56, and 51 & 52 Vict., cap. 12.

† 53 & 54 Vict., cap. 13.

‡ **References.**—The Electric Lighting Acts of 1882 and of 1888 are respectively indicated thus: (1882) and (1888); a figure immediately following indicates the section of the Act referred to. References such as (Rule 1), &c., refer to the Board of Trade Rules of 1890, while (Clause 1), &c. refer to Clauses of the Model Order, No. 2 form, unless otherwise stated.

‖ This has not been applied to the City, for which the three Orders hitherto granted contain certain special peculiarities, notably in the clauses relating to transfer and purchase of the undertaking, the method of keeping accounts, and reduction of prices for supply on a sliding scale.

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PART I.

PRELIMINARIES TO UNDERTAKING THE SUPPLY OF ELECTRICITY.

CHAPTER I.

Supply Outside the Acts.

Before proceeding to deal with those who supply electricity under Parliamentary powers, called by the Acts "Undertakers," mention should be made of the position of persons who may supply electricity without obtaining such powers.

Previously to the Electric Lighting Acts such persons might place their conductors wherever they could get leave to do so; though for breaking up streets, &c., even with consent of the Local Authority, they were liable to indictment for causing a nuisance. It was held, however, that Local Authorities have no more power of interfering with overhead wires crossing the streets than is possessed by ordinary members of the public * (*see* Wandsworth Board of Works *v.* United Telephone Company, Limited, 13 Q.B.D., 904). On the other hand, it must be borne in mind that private individuals could always prevent wires passing over their property, even though not attached to anything upon it.

The Act of 1882 had no effect upon this state of things, but (1888) § 4 rendered all electric lines, or other work laid down or erected in, over, along, across, or under any street, for the purpose of supplying electricity, liable to Regulations of the Board of Trade for the protection of public safety and of telegraph works. The Regulations † issued by the Board of Trade under this Section provide that the height of an aerial conductor must not be less than 20ft., or 30ft. where crossing a street, nor be within 6ft.‡ of any building, except when brought in for purposes of supply, and the angle of crossing a street must not be less than 60deg. The spans must not exceed 200ft., or 150ft. if the direction is curved or dips. They prescribe the factors of safety for wires, supports, &c., efficient earth connections for metal supports and coverings, lightning conductors and protectors, precautions against contact with other wires, the maximum working current, and also specify for insulation, mode of suspension, and devices for indicating leakage where high pressure is used. For alternating currents the two conductors must be parallel, and not more than 18in. apart. A plan of all aerial conductors is to be lodged with the Postmaster-General, and all supports are to bear a mark indicating their ownership. All conductors and supports are to be efficiently supervised and maintained by the owners, and removed when use has ceased. (*See* also Part II., Chap. 5. C.)

These Regulations do not apply, and the Section does not extend, to telegraph wires, nor to wires laid under Parliamentary powers, nor do they affect conductors entirely enclosed within buildings, or used for supplying electricity from one part of premises to another in the same occupation. Substantially similar conditions are, however, imposed under the wider Regulations issued with Provisional Orders.

* Urban Authorities, under the Public Health Amendment Act, 1890, Part ii., and the London County Council, under the London Overhead Wires Act, 1891, have since acquired powers to make bye-laws, subject to confirmation by the Board of Trade, with respect to overhead wires and their accessories not laid by undertakers under the Electric Lighting Acts.

† These are now under revision. New Regulations will be issued about the spring of 1894, and will be published with the "Digest" in book form.

‡ Owing to the length of Metropolitan fire-escapes, the Regulations issued under the London Provisional Orders require the height above the street to be 35ft. The same Regulations under both the London and Provincial Orders require the distance from a building to be 7ft. instead of 6ft.

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CHAPTER II.

Parliamentary Powers.

Three methods are provided by the Acts for obtaining Parliamentary powers to supply electricity within a defined area, viz., Special Act, License, and Provisional Order.

A.—Special Act.

This method calls for but little notice. Only one Special Act* has hitherto been passed, and that under exceptional circumstances. In the absence of such it is unlikely that future applications under this head will be successful. But however this may be, it is improbable that Parliament will grant more favourable terms by Special Act than may be obtained by Provisional Order.

B.—License.

This must also be regarded as a method of secondary importance. The Board of Trade announced as early as 1883 that, except in case of applications by Local Authorities, Licenses would not be granted for large areas, such as the whole of a provincial town, or a London parish. The present tendency is to further curtailment. Only seven Licenses were granted in 1890 as against 74 Provisional Orders; and only five since. They are only now granted under exceptional circumstances, and usually on terms that a Provisional Order is to be applied for on the earliest opportunity. The following provisions apply to Licenses.

The Term cannot exceed seven years, although it may be renewed upon the same conditions as are applicable to an original grant.

The Consent of the Local Authority must be obtained in the manner specified under the head of Procedure, and if this consent is withheld, a License cannot be even applied for.

A License cannot be granted until **Three Months after notice** has been advertised, and the formalities completed, as stated under the head of Procedure.

The proceedings are regulated by (1882) § 3, and the Board of Trade Rules above referred to.

The compulsory powers of purchase by Local Authorities do not apply to undertakings authorised by License. In other respects Licenses contain substantially the same clauses as Provisional Orders.

The **Advantages of Proceeding by License** are, that it can be more expeditiously and cheaply obtained, and is not hampered by any requirements as to notices being given before fixed days in the year. It does not require confirmation by Parliament. This, however, entails the disadvantage that certain provisions, which may be valid in a Provisional Order, would be *ultra vires* in a License; notably those for enforcing payment of penalties, for which the Acts do not provide any machinery.

C.—Provisional Order.

This is by far the most important method of proceeding. The grant is made by the Board of Trade, but must be confirmed by Parliament, where the Bill may be opposed, as well as before the Board of Trade.

The proceedings are regulated by (1882) § 4, and the aforesaid Rules.

* The Metropolitan Electric Lighting Act, 1889. The Special Acts obtained in 1893, by the City of London Electric Lighting Company and the Kensington and Knightsbridge Electric Lighting Company, respectively, relating to amalgamations of undertakings, do not fall within the same category.

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Notice must be served on every Local Authority within the proposed area of supply **before July 1st** in the year in which the application is to be made, and Rule 7 states that the Order will be granted only to the party by whom this Statutory Notice was given. Rule 5 also requires notice to be given to all other undertakers within the area before November 1st.

Advertisements, as described under the head of Procedure, must be published in the months of October or November following, and copies of the advertisement and a **Map** of the proposed area deposited at the Board of Trade, and at the offices of every Clerk of the Peace* and Local Authority within the area, on or before November 30th. (Rules 10 and 17.)

The Memorial applying for the Order, and documents mentioned under the head of Procedure as required to accompany it, must be lodged at the Board of Trade on or before December 21st.

The applicants must be prepared to prove compliance with the Acts and Rules by January 15th following, and proofs must be completed by February 22nd.

The confirmation Bill may be passed at any time before the end of the current Session of Parliament.

The **Order Dates** from the day when the confirming Act is passed.

The other preliminaries which are common to Licenses and Provisional Orders are described under the head of Procedure.

The **Consent of the Local Authority** is rendered necessary to the grant by (1888) § 1, but the Board of Trade have power to dispense with this consent† on sufficient grounds to be stated in a special report. Proof of such consent, or a request to dispense with it, giving reasons, must be lodged within the time above limited for proving compliance. (Rule 2.)

The liability to **Compulsory Purchase** of the undertaking, by the Local Authority, at the end of 42 years, is one of the incidents of a Provisional Order. The terms of purchase, unless varied by agreement between the parties with the consent of the Board of Trade under (1888) § 3, are laid down by (1888) § 2, which stands as follows :—

"Where any undertakers are authorised by a Provisional Order or Special Act to supply electricity within any area, any Local Authority within whose jurisdiction such area or any part thereof is situated, may within six months after the expiration of a period of 42 years, or such shorter period‡ as is specified in that behalf in the Provisional Order or in the Special Act, from the date of the passing of the Act confirming such Provisional Order, or of such Special Act, and within six months after the expiration of every subsequent period of 10 years, or such shorter period as is specified in that behalf in the Provisional Order or in the Special Act, by notice in writing require such undertakers to sell, and thereupon such undertakers shall sell to them their undertaking, or so much of the same as is within such jurisdiction, upon terms of paying the then value of all lands, buildings, works, materials, and plant of such undertakers, suitable to and used by them for the purposes of their undertaking within such jurisdiction, such value to be in case of difference determined by arbitration. Provided that the value of such lands, buildings, works, materials, and

* In Scotland the office of every principal Sheriff Clerk.

† This power has been rarely exercised since 1889, when several Provisional Orders were granted and confirmed by Parliament, notwithstanding opposition by the Local Authority.

‡ Shorter periods have been accepted by undertakers in some cases. In the County of London form the term runs from August 26, 1889.

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plant shall be deemed to be their fair market value at the time of the purchase, due regard being had to the nature and then condition of such buildings, works, materials, and plant, and to the state of repair thereof, and to the circumstance that they are in such a position as to be ready for immediate working, and to the suitability of the same to the purposes of the undertaking, and where a part only of the undertaking is purchased, to any loss occasioned by severance; but without any addition in respect of compulsory purchase, or of goodwill, or of any profits which may or might have been, or be made from the undertaking, or of any similar considerations. The Board of Trade may determine any other questions which may arise in relation to such purchase, and may fix the date from which such purchase is to take effect; and from and after the date so fixed, or such other date as may be agreed upon between the parties, all lands, buildings, works, materials, and plant so purchased as aforesaid, shall vest in the Local Authority which has made the purchase, freed from any debts, mortgages,* or similar obligations of such undertakers, or attaching to the undertaking; and the powers of such undertakers in relation to the supply of electricity under this Act, or such Provisional Order or Special Act as aforesaid within such area or part thereof as aforesaid, shall absolutely cease and determine, and shall vest in the Local Authority aforesaid."

Subject to the above right of purchase by the Local Authority, a Provisional Order, unlike a License, may be "for such period, whether limited or unlimited, as the Board of Trade may think proper." (1882, § 4.) No limits have been imposed hitherto.

D.—Procedure for Obtaining a License or Provisional Order.

Advertisements of an application having been made for a License, or of an intended application for a Provisional Order, must state (*see* Rule 13) the objects of the application; the address and description of the applicants; a description of the proposed area of supply, the streets in which lines are to be laid down within a specified time; a list of streets not repairable by a Local Authority and of the railways and tramways which the applicants require powers to break up; the address of an office in London, and another in the proposed area, where printed copies of the draft License or Order can be obtained at a price not exceeding 1s. It must also inform the public that objections should be lodged by letter addressed to the Board of Trade, in case of a Provisional Order before the following January 15th, and in case of a License within two months from the first advertisement. (A note of this latter fact must also be printed at the end of the draft: *see* Rule 9.) The advertisement must be inserted once at least in each of two successive weeks in the same newspaper, circulating in the proposed area, or such other newspaper as the Board of Trade may direct, and once in the London, Edinburgh, or Dublin *Gazette*, according as the area of supply is in England, Scotland, or Ireland.

The formalities for proving the **Consent of the Local Authority** to an application for a License, or the grant of a Provisional Order, are prescribed by Rule 4. Copies of any agreement with the Local Authority must be deposited with the Board of Trade at the time of proving consent (Rule 3).

Applications must be by **Memorial** addressed to the Board of Trade, accompanied by six printed copies of the draft Order or License applied for (Rule 8).

* Clause 76 of the Model Order provides that mortgages shall not be a charge on the undertaking in the event of sale, but shall comprise the purchase-money, and every mortgage shall be endorsed with a notice to that effect.

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The contents of the draft are prescribed by Rule 9, and the maps to be deposited by Rule 10.

Accompanying the memorial **there must be deposited with the Board of Trade** (Rule 11)—

1. A list of the Local Authorities whose districts are included in the area of supply. 2. A list of other undertakers* (if any) within the area. 3. A list of streets not repairable by Local Authorities, and of railways and tramways which the applicants desire to break up. 4. A list of canals and railways within the area. 5. A statement of the capital to be expended, and the mode of providing it. 6. If the applicants are a company, a copy of their Memorandum and Articles of Association. 7. A fee of £50 to cover ordinary expenses of the Board of Trade. Further expenses, if incurred in consequence of inquiries or otherwise, must be paid by the applicants in addition to the above.

The procedure where undertakers desire the consent of the Board of Trade, under (1882) §13, to enable them to break up any **street not repairable by a Local Authority,** or any **railway** or **tramway,** is prescribed by Rule 12.

The manner of **serving notices** is prescribed by Rule 7.

Objections to the grant, and copies of any clauses or amendments desired, must be delivered to the Board of Trade and to the agents of the undertakers before January 15th in the case of a Provisional Order, and within two months after the first advertisement in the case of a License (Rule 14). This rule contemplates clauses or amendments being asked for by "any Local or other public authority, company or person," and therefore opens a very wide field for objections.

The Board of Trade will hold a local inquiry, † if they consider it expedient, in cases where objectors are locally interested.

Printed Copies of the License or Provisional Order must be deposited for public inspection at the office of every Clerk of the Peace ‡ and Local Authority within the area of supply, and the undertakers must supply copies to all persons applying, at 1s. each (Rule 15).

PART II.

POSITION OF UNDERTAKERS AND RIGHTS OF THE PUBLIC AFTER PARLIAMENTARY POWERS HAVE BEEN GRANTED.

Introductory.

It is provided by (1882) § 3 (sub-section 8), that a License may make certain regulations, and Section 4 states that a Provisional Order shall be subject to like provisions. The same provisions are, however, also authorised by Section 6, which is much more comprehensive, and stands as follows :—

"The undertakers shall be subject to such regulations and conditions as may be inserted in any License, Order, or Special Act affecting their undertaking with regard to the following matters :

(*a*) The limits within which, and the conditions under which, a supply of electricity is to be compulsory or permissive.

(*b*) The securing a regular and efficient supply of electricity.

* Notice must be given to all such undertakers before November 1st (*see* Rule 5).
† There have been three such inquiries since 1889.
‡ In Scotland, principal Sheriff Clerk.

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(*c*) The securing the safety of the public from personal injury, or from fire or otherwise.

(*d*) The limitation of the prices to be charged in respect of the supply of electricity.

(*e*) The authorising inspection and inquiry from time to time by the Board of Trade and the Local Authority.

(*f*) The enforcement of the due performance of the duties of the undertakers in relation to the supply of electricity by the imposition of penalties or otherwise, and the revocation of the License, Order, or Special Act where the undertakers have, in the opinion of the Board of Trade, practically failed to carry the powers granted to them into effect within a reasonable time, or discontinued the exercise of such powers; and

(*g*) Generally with regard to any other matters in connection with the undertakings.

Provided always that the Board of Trade may from time to time make such regulations as they may think expedient for securing the safety of the public from personal injury, or from fire or otherwise, and may from time to time amend or repeal any regulations which may be contained in any such License, Order, or Special Act in relation thereto; and any regulations so made or amended by the Board of Trade shall from and after the date thereof have the like effect in every respect as though they had been originally inserted in the License, Order, or Special Act authorising the undertaking, and every regulation so repealed shall, from and after the date thereof, be repealed accordingly; but such repeal shall not affect any liability or penalty incurred in respect thereof prior to the date of such repeal, or any proceeding or remedy which might have been had in relation thereto.

Any Local Authority within any part of whose district electricity is authorised to be supplied under any License, Order, or Special Act may, in addition to any regulations which may be made under the preceding provisions of this section for securing the safety of the public, from time to time, make, rescind, alter, or repeal bye-laws for further securing such safety; and there may be annexed to any breach of such bye-laws such penalties, to be recovered in a summary manner, as they may think necessary: *Provided always* that no such bye-laws shall have any force or effect unless and until they have been confirmed by the Board of Trade, and published in such manner as the Board of Trade may direct."

It is by virtue of these sections that the terms laid down in the Model Order are imposed by the Board of Trade, which will now be considered, together with other sections of the Acts, under the following titles:—

Chap. I. General obligations of undertakers and miscellaneous provisions.
„ II. Rights of undertakers.
„ III. Regulations as to laying down mains, &c., and testing same.
„ IV. Rights of the public to obtain supply, and their obligations in connection therewith.
„ V. Position of Local Authorities, County Councils, and the Postmaster-General.

CHAPTER I.

General Obligations of Undertakers and Miscellaneous Provisions.

A.—*Accounts, Maps, and other Documents to be kept, published, or deposited by Undertakers.*

Printed Copies of all Regulations affecting the undertaking issued by the Board of Trade must be served on the Local Authority, and copies supplied to all

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persons applying, at a charge of 6d. each, under penalty of £5, and a similar daily penalty * (Clause 68).

Annual Accounts must be published in such form and manner as the Board of Trade may approve, by March 25th in each year, made up to the previous December 31st, and copies be supplied to all applicants at 1s. each. Penalty for default, 40s. a day (1882) § 9. These accounts are to be audited by an auditor appointed by the Board of Trade † (Clause 8). This Clause is not applicable to undertakings by Local Authorities. Orders subsequent to 1891 omit the requirements inserted in Orders hitherto, as to separate capital accounts being kept in respect of each Order.

Maps (1) of the area of supply in form required by Rule 16 must be deposited at the Board of Trade within one month from the date of the grant, (2) of the area, showing the exact position of all underground works in manner required by Clause 57, must be kept at the undertakers' principal office, and corrected once a year. All applicants may inspect, on payment of 1s., and have copies at 5s. each. Penalty for undertakers' default £10, and £2 daily penalty.

Forms of Requisition to lay mains referred to in Chapter 4, A, must be kept and supplied gratis.

B.—*Security to be Given.*

Undertakers (if not a Local Authority) must within six months, ‡ and before exercising any powers, satisfy the Board of Trade that they are in a position fully and effectually to discharge their obligations, and must make a cash deposit or give security.‖ For failure in this respect the Board of Trade may revoke the Order as to the whole or part of the area. The security will be released in equal moieties, on the certificate of the Board of Trade Inspector that an equivalent has been expended by the undertakers, or that distributing mains have been laid in all the scheduled streets, or otherwise as the Board may approve (Clause 7).

In case of the undertakers' powers being revoked, claims for compensation in respect of damage consequent upon works or other exercise of their powers, or for the cost of removal of their works, are to be a first charge on the money deposited or secured, which is to be applied rateably in satisfaction of such claims, as may be determined by a Board of Trade arbitrator (Clause 66*e*).

C.—*Amalgamation.*

Undertakers (not being Local Authorities) are forbidden,¶ under penalty of revocation, to purchase or acquire the undertaking of, or associate themselves with,

* This expression is defined in Clause 2 to mean a penalty for each day on which an offence is continued after conviction thereof.

† The Orders previous to 1892 for the Provinces direct the auditor to be appointed by the County Council, those for Scotland by the Sheriff.

‡ When anything has to be done within a fixed period, unless otherwise stated, the period is understood to date from the commencement of the Order, which is defined by Clause 3 to be the day on which the Act of Confirmation is passed.

‖ Where two or more Local Authorities' districts are involved, the deposit or security may be required to be in respect of such districts severally ; and, in such case, will be released separately. The Board generally require £1,000 in respect of each district for the Metropolis, and £500 for the Provinces. Local Authorities may, however, stipulate for larger sums, as in the case of the parish of Paddington, where the undertakers in 1890 were required to give security for £20,000.

¶ The only three Orders granted for the Provinces in 1889, namely, Birmingham, Liverpool, and Swansea (the latter being a Local Authority), do not contain this prohibition. The City of London Orders contain special powers of transfer.

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any other company or person supplying electrical energy under any License, Provisional Order, or Special Act without the sanction of Parliament (Clause 4).

D.—*Liability for Nuisance, Injury, &c.*

No statutory powers are given to undertakers which will exempt them to the extent of Railway Companies from injunction or indictment for nuisance.

The existing state of the law is emphasised, but not altered in any way by Clauses 75 and 79, the one providing that "The undertakers shall be answerable for all accidents, damages, and injuries happening through the act or default of the undertakers or of any person in their employment by reason or in consequence of any of the undertakers' works, and shall save harmless all authorities, bodies, and persons by whom any street is repairable, and all other authorities, their officers and servants, from all damages and costs in respect of such accidents, damages, and injuries;" and the other, that "Nothing in the Order shall exonerate the undertakers from any indictment, action, or other proceedings for nuisance in the event of any nuisance being caused by them."

The first of these clauses might appear to extend the liability of undertakers to accidents where they have been guilty of no negligence or default. This, however, has been held not to be the case in the interpretation of similar words under the Tramways Act, 1870, section 75 (*see* Brocklehurst *v.* Manchester, &c., Tramways Company, 17 Q.B.D., 118).

E.—*Future Grants and Acts of Parliament.*

No monopoly is granted to undertakers, and (1888) § 1 expressly declares that a grant by License or Provisional Order shall not restrict subsequent grants for the same area. The Board of Trade do not, however, hastily favour competition, and decided in 1890 to refuse Orders in respect of those portions of the Metropolis which were dealt with by the Orders of 1889, on the ground that it was not desirable to interfere with the arrangements then made until further experience had been gained.*

It is also declared by Clause 80 that undertakers are not exempted from the provisions nor deprived of the benefit of any future general Act.

F.—*Revocation.*

The power to revoke a License, Provisional Order, or Special Act is given to the Board of Trade by (1882) § 6 (*f*) (quoted above), in the events therein mentioned.

The Model Order prescribes eight† occasions for the exercise of this power, namely, if the undertakers—

(1) Amalgamate with another undertaking without the authority of Parliament (Clause 4).

(2) Supply outside their own area (Clause 6).

(3) Fail to find security or make deposits as required by Clause 7.

(4) Fail to lay compulsory mains (Clause 21).

(5) Fail to execute works or supply energy as required, and are, owing to insolvency, unable fully and efficiently to discharge the duties imposed on them (Clause 63).

* The grant in 1891 of an Order to the new Cadogan and Belgrave Electric Supply Company for a part of the parish of Chelsea, in which two other Companies already held Orders, was made under circumstances treated by the Board as exceptional.

† When the Local Authority are the undertakers, Nos. 1, 2, 3, and 7 do not apply, and No. 5 is altered by omitting any reference to insolvency.

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(6) Fail to comply with an order of the Board of Trade to discontinue or abate an irregularity or defect (Clause 67).

(7) Satisfy the Board of Trade that they are unable to carry on the undertaking with profit, and that it ought to be abandoned. In this case the undertakers must themselves apply for revocation (Clause 64).

(8) In addition to the above, the Board of Trade may revoke on such terms as they may think just, at any time, with consent of the undertakers and Local Authority (Clause 65).

In all these cases, except the 1st, 2nd, 6th, and last, the revocation may be partial, if the undertakers so desire, and as regards the 7th case, if the Local Authority also consent. In the 4th case it is also provided that after hearing representations from the Local Authority, the Board may suffer the Order to remain in force, subject to such conditions as they may impose, and which are thereupon to become of like force as though they had been contained in the original Order.

On revocation of an Order, the following provisions take effect (Clause 66).

Within one month after service of notice of revocation, the Local Authority may require the undertakers to sell so much of their undertaking as is comprised in the revoked area, upon the terms of the compulsory purchase section (1888) § 2. Upon such sale being effected and transfer directed by the Board of Trade, the undertaking, or the part thereof purchased, vests in the purchasers, freed of all debts, mortgages, or similar obligations, and the Order is to remain in force in favour of the purchasers. Mortgages would be a charge on the purchase-money under Clause 76.

If no purchase is effected, the Local Authority or owners of streets in which works of the undertakers have been placed may, with reasonable care, remove such works, and the undertakers must pay the costs of removal and of reinstating the streets, the amount to be settled by arbitration. After a month's default in payment, such works may be sold, and the proceeds, after defraying expenses paid to the undertakers.

G.—*Approvals, Extensions of Time, Consents and Orders of the Board of Trade.*

The form of these, their incidents, and the advertisements required are prescribed by Clauses 70, 71 and 72. Notice of an application for extension of time by undertakers must be given to the Local Authority, who are to have an opportunity of making objections thereto (Clause 73).

H.—*Notices, &c.*

The form of these and manner of service are prescribed by Clauses 61 and 62, Sundays, Christmas Day, Good Friday, Bank Holidays, and days of public thanksgiving, &c., do not count in computations of time.

I.—*Arbitration.*

Unless in any case it is otherwise expressly provided, all matters directed under the general Acts, or any License, Order, or Special Act, to be determined by arbitration, are to be determined by an engineer or other fit person nominated on the application of either party by the Board of Trade, under the Board of Trade Arbitrations, &c., Act, 1874 (1882, § 28).

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J.—*Recovery of Penalties.*

Where not otherwise provided for, penalties, recoverable under Provisional Orders or Regulations made thereunder or under the Acts, may be recovered before a Court of Summary Jurisdiction. They may if the Court so direct be paid to the prosecutor (Clause 74).

The obligations of undertakers as to *Compulsory Supply* are dealt with in Chapter IV.

CHAPTER II.

Rights of Undertakers.

The general enabling provisions of the Electric Lighting Acts are contained in (1882) § 10, which is as follows :—"The undertakers may, subject to and in accordance with the provisions and restrictions of this Act, and of any rules made by the Board of Trade in pursuance of this Act, and of any License, Order, or Special Act authorising or affecting their undertaking, and for the purpose of supplying electricity, acquire such lands by agreement, construct such works, acquire such licenses for the use of any patented or protected processes, inventions, machinery, apparatus, methods, materials, or other things, enter into such contracts, and generally do all such acts and things as may be necessary and incidental to such supply."

A.—*Powers of Acquiring Land.*

This is by agreement only, the compulsory provisions of the Lands Clauses Acts being expressly excluded by (1882) § 12. Special powers are given to Local Authorities who are undertakers, by Clause 7, of Form No. 1, subject to approval of the Local Government Board as regards using lands previously acquired for other purposes.

B.—*Power to Supply Electricity.*

This power, which (1882) § 3 and § 4 enacts may be given by License or Provisional Order, is granted by Clause 9 of the Model Order within the area defined by a schedule.

Undertakers (other than the Local Authority) are forbidden under Clause 6, on pain of revocation, to erect or lay down any lines or works outside their area without the authority of Parliament or a License.

C.—*Protection of Undertakers' Property from Injury or Seizure.*

Maliciously cutting or injuring any electric line or work with intent to cut off supply is made felony by (1882) § 22, and punishable with five years' penal servitude or two years' imprisonment. Maliciously or fraudulently abstracting, or causing to be wasted or diverted, consuming, or using electricity is declared by (1882) § 23 to be larceny, and punishable accordingly. Fraudulently injuring a meter, or where supply is not charged by meter, using any lamp either larger or for a longer time than contracted for, or supplying any other person with any part of the electricity supplied by undertakers, involves, under § 18 of the Gas Works Clauses Act, 1847, a forfeit to the undertakers of £5, and 40s. daily penalty. Damaging any line, post, lamp, or other work of the undertakers, or wilfully extinguishing public lamps or wasting electricity, involves a forfeit to the undertakers of £5, in addition to

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the amount of damage, under § 19 of the same Act. And under § 20 anyone carelessly or accidentally breaking, throwing down, or damaging any such line, pillar, or lamp must pay damages not exceeding £5.

In addition to the above penalty and damages, undertakers are empowered, under § 38 of the Gas Works Clauses Act, 1871, in the case of anyone wilfully or fraudulently, or by culpable negligence, injuring any line, meter, or fittings of the undertakers, or tampering with a meter, or fraudulently abstracting or consuming or using electricity, to cut off the supply until the default is made good. The existence of artificial means of committing any of the above offences is also made evidence of fraudulent intent. (As to improper use by consumers, *see* also Chapter IV. B.)

Undertakers' property is protected from distress, execution, or bankruptcy proceedings against any person in whose possession it may be by (1882) § 25.

D.—*Powers for Securing and Recovering Payments for Supply. Right of Entry on Consumer's Premises.* (*See* Chapter IV., G and K.)

E.—*Power to Break up Streets.*

This is not expressly given by the Acts, but is imported from the Gas Works Clauses Act, 1847, which is incorporated by (1882) § 12.

Undertakers are forbidden by (1882) § 13 to **break up private streets, railways, or tramways,** without the consent of the Board of Trade. Clause 10 of the Model Order gives this power as regards streets, &c., specified in a schedule, which may be afterwards added to by the Board of Trade. Clause 11 authorises **street boxes** to be placed in any street which, except so far as the Board of Trade shall otherwise direct, are to be for the sole use and under the sole control of the undertakers. No such box is to be placed above ground without the consent of the Local Authority, body, or person by whom the street is repairable. The covers must be constructed and maintained so as not to be a source of danger, and must not be removed, except at stated hours prescribed by the Local Authority, under a penalty of £5, and a like daily penalty, unless in case of emergency.

The regulations and restrictions under which these powers may be exercised are stated in the following chapter.

CHAPTER III.

Regulations as to Laying Down Mains,* &c., and Testing Same.

The sections of the Gas Works Clauses Act, 1847, which apply to this subject are Nos. 6 to 12. Some of these are practically superseded by the more elaborate provisions of the Model Order on the same subject, but Sections 10 and 11 should be noticed, which compel undertakers, under penalty of £5 a day for default, to reinstate ground broken up, convey away all rubbish, fence the works while in operation, and light them at night, also to keep the road or pavement in repair for three months after breaking up, and for 12 months as regards subsidence. Penalties for want of due diligence or care in such matters are also recoverable under Section 160 of the Public Health Act, 1875, incorporating Sections 81 to 83 of the Towns Improvement Clauses Act, 1847.

* The Provisions of the Model Order under the head of "Works" are very long and elaborate. No more than a very brief summary can be given here.

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(1882) §17 also provides that the undertakers in exercising their powers are to cause as little detriment and inconvenience as possible, and make compensation for damage done, to be settled by arbitration.

A.—*Requirements before breaking up Streets, &c.*

Except in the case of repairs, renewals, or amendments of existing works, undertakers must, before proceeding, give a month's notice to the body or person liable to repair the street or bridge, or the owner of the railway, tramway, or canal to be disturbed, also to the Postmaster-General. The notice must describe the proposed works with a plan. The undertakers may execute the works, if no objection is served upon them for three* weeks after notice; but in case of objections by any of the Local Authorities or Postmaster-General, the work may only be done on conditions approved by the Board of Trade, or in case of objections by other parties, on terms to be settled by arbitration. All works must be done to the reasonable satisfaction of such owners, who may be present during their execution (Clauses 12 and 13). The repairing authority or owners may (Clause 14) give notice that they will execute the required works for and at the expense of the undertakers, and may (unless the undertakers are the Local Authority) require security for the cost, in which case the undertakers must not do the works, unless the party so giving notice neglects to do so for 24 hours after a time specified by a further requisition to be served by the undertakers not more than four or less than two† days before the time so specified. Breach of any of these regulations involves a penalty on the undertakers of £10, and £5 daily penalty; but they will be excused if the case is one of emergency, and they have complied with the requirements so far as was reasonable under the circumstances.

B.—*Mutual Facilities to Undertakers and the Owners of other Pipes, Wires, &c.*

These are granted by (1882) §15, "Subject to the provisions of this Act, and the License, Order, or Special Act, and to any Bye-laws made under this Act."

Special regulations are accordingly laid down in the Model Order to be observed by undertakers and the owners of pipes, wires, &c., under any street, as regards interference with each other's works. Clause 15 makes similar provisions to those described under (A), with respect to notices to be given to the parties whose property is to be interfered with, the right of the latter to do the work themselves, arbitration, and penalties for breach. The sewers of the Local Authority are excluded from the scope of this clause.

These mutual rights are extended by Clause 16 to the case of undertakers requiring to dig, for laying new works (other than service lines) near to any sewer, drain, water-course defence or work under the jurisdiction of the Local Authority, or any pipe or line of any gas, water, or electric supply company, or *vice versâ*. Three days' notice must be given to the parties affected, who may superintend the work and make requirements for protection of their property (and under the County of London form, do the work themselves, unless undertaken by the Street Authority). Compensation must be paid for any loss or damage entailed.

* Where the objectors are the Local Authority or Postmaster-General, this is extended to "one month," and also the month of August is not to count in the period of notice, unless the undertakers are the Local Authority. It may be remarked that apart from the special requirements of Provisional Orders undertakers would only have to give three clear days' notice before breaking up a street under the Gas Works Clauses Act, 1847, § 8.

† Under the corresponding provisions of Clause 15 referred to under B these periods are 48 hours and 24 hours.

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Works must be supported in case of being undermined, and lines sufficiently insulated wherever liable to touch the pipes or lines of any gas, water, or electric supply. These must not be used as conductors without the consent of the owners and the Board of Trade. Differences are to be settled by arbitration. The penalties for breach are the same as in the preceding clauses, but are not to be enforced if the default arose through ignorance (not due to negligence) as to the position of the works affected.

C.—*Protection of Telephone Companies, &c., and Owners of Docks, Canals, Railways, &c.*

Undertakers must take all reasonable precautions so to construct their works as not to injure, by induction or otherwise, any existing or future wires used for telegraphic or telephonic communication. Before laying or commencing to use any line in a manner which may injuriously affect telegraphic or telephonic communication through wires lawfully laid, seven days' notice must be given specifying the course, nature, and gauge of the said line, the amount and nature of the current, and what earth returns (if any) will be used. The undertakers must conform to any reasonable requirements, thereupon made by the owners of such wires, and any differences between the latter and the undertakers as to the reasonableness of such requirements are to be settled by arbitration. The arbitrator may direct alterations to be made, unless he is of opinion that wires laid since those of the undertakers have been laid unreasonably near them. These provisions do not apply to repairs or renewals, provided the course, nature, and gauge of the line, and the amount and the nature of the current are not altered. The penalties for breach are £5, and 40s. daily penalty, with the same exemption as in the last clause in case of ignorance (Clause 18). No part of a circuit may be connected to earth unless approved by the Board of Trade and the Postmaster-General (Clause 9).

Undertakers must, at the request of owners of canals, docks or basins, on having reasonable facilities afforded for placing their works round the same, or any land about to be used for such purposes, place or remove the said works accordingly. Disputes on the subject are to be settled by arbitration (1882, § 16). Besides the notices required and protection given by Clause 13 (*see* A, *ante*), Clause 17 expressly forbids undertakers to injure the works or obstruct the traffic of any railway or canal company.

D.—*Wires above Ground.*

These may not be erected along, over, or across any street without the consent of the Local Authority (1882, § 14). The Model Order (Clause 9) further forbids any line to be placed above ground without the consent of the Board of Trade, except within premises in the sole occupation or control of the undertakers, and except so much of any service line as is necessarily so placed for the purpose of supply. Lines placed above ground before the grant must be removed within a year, under a penalty of £10, and £5 further daily penalty, and on failure may be removed by order of a Court of Summary Jurisdiction (Clause 81). (*See* also Part I., Chapter I., and E, below).

E.—*Precautions for Public Safety.*

The Act of 1882, § 6, as quoted above, empowers the Board of Trade from time to time to make, amend or repeal regulations for securing public safety. It also

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empowers the Local Authorities to make bye-laws * on the same subject. Under the Model Order (Clause 9) undertakers are made subject to such regulations and conditions for securing the safety of the public, and for insuring a proper and efficient supply as the Board of Trade may impose. In 1890, the Board framed a set of such regulations, which have been issued in substantially the same form to all undertakers.† The first part relates to safety, and the second part (*see* Chapter IV., E) to supply.

The Regulations as to safety require as follows:—

The supply must be delivered at the consumer's terminals at low pressure (*i.e.*, not exceeding 300 volts continuous, or 150 volts alternating). A high-pressure supply (*i.e.*, up to 3,000 volts) may only be delivered to a consumer for special purposes with the approval of the Board of Trade on a joint application of undertakers and consumer. Extra high pressure (*i.e.*, above 3,000 volts) is confined to premises in the sole occupation of the undertakers. Precautions and rules are laid down for avoiding excessive currents, for protection from lightning, as to laying high-pressure conductors and insulation thereof, the use of instruments for immediately indicating leakage, the taking and recording by the undertakers of weekly insulation tests, the nature of conduits used as receptacles for conductors, and for avoiding accumulation of gas or water in street boxes, or electrical charge on exposed parts thereof, also in the case of conversion from high to low tension, for preventing the low-pressure lines and consumer's wires from attaining a dangerous potential. Undertakers are made responsible for all their apparatus upon a consumer's premises being maintained in safe condition, and must take precautions against fire. If an earth connection is discovered on a consumer's premises of resistance not exceeding 5,000 ohms, or if the consumer refuses to allow his wires to be tested after due notice (*see* chapter IV., I), the supply is to be‡ cut off until the defect is rectified; but if the consumer takes a maximum power exceeding 25,000 watts, his wires may be divided into separate circuits, each of whose insulation resistance must exceed 5,000 ohms. The provisions as to aerial conductors are substantially similar to those issued under (1888) § 4 (*see* Part I., Chapter I.). The penalty for every default is £10, and a like daily penalty. (For a complete copy of these Regulations *see* pages 112-119.)

Clause 67 also specially provides for the intervention of the Board of Trade in the event of undertakers' works being defective, or not in accordance with regulations, or attended with danger to public safety, or injuriously affecting any telegraphic line of the Postmaster-General. Any requirements thereupon made by the Board must be complied with under penalty of £20 a day, or the Board may forbid the use of any line until their order is complied with under penalty of £100 a day, or under certain circumstances revocation.

Under (1882) § 14, a Court of Summary Jurisdiction is empowered, upon complaint made, to order the removal of any overhead wires which are or appear likely to become dangerous, notwithstanding that the same may have been erected with the consent of the Local Authority.

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* No such bye-laws have been made hitherto by any Local Authority.

† These are now under revision, and a new set of Regulations will be issued early in 1894.

‡ A copy of Regulation 25, which enables a consumer upon payment of the prescribed fee to demand a test by an Electric Inspector, must be endorsed on the notice to be given by the undertakers of cutting off the supply.

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F.—*Electric Inspectors and Testing.*

Electric Inspectors may be appointed by the Local Authority,* or if the latter make no appointment, *or imperfectly attend to the matter*, the Board of Trade may appoint on the application of any consumer or of the undertakers.

Electric Inspectors' duties are: (*a*) The inspecting and testing periodically,† and in special cases, the undertakers' lines and works, and the supply given; (*b*) the certifying and examination of meters; and (*c*) such other duties as may be required by Provisional Orders or regulations made under them.

The Local Authority, with the approval of the Board of Trade, may prescribe the manner and times of performing these duties, and the fees to be taken (Clause 33), and may pay any Inspector a salary, either in addition to or in substitution for the fees he is to charge (Clause 34).

The Board of Trade may also appoint an Electric Inspector to inquire and report as to any accident, or as to the manner in which the provisions for public safety have been complied with (Clause 35).

Testing is to be carried out in such manner as the Inspector thinks fit, and at such suitable hours as in his opinion will least interfere with the supply, but he is not, without a special order of the Board of Trade, to have access to the mains at other points than those reserved by the undertakers for their own access. The undertakers are to have notice before testing, and are not to be responsible for interruption of the supply caused or required by the Inspector (Clause 36).

When required by any consumer, and on payment of the prescribed fee, Inspectors are to test the variation of pressure at the consumer's terminals, and make such other tests as may be necessary for determining whether the undertakers have complied with their duties (Clause 37).

Undertakers must establish such **testing stations** as may be reasonably required by the Local Authority,‡ and place instruments therein approved by the Board of Trade, and make proper connections, and supply energy for testing. Any dispute between the Local Authority and the undertakers as to what may reasonably be required under this clause is to be settled by arbitration (Clause 38). They must set up at all places whence they supply energy by distributing mains such instruments, and keep such records of their readings, as the Board of Trade may require, and must keep in efficient order the above instruments, and those at testing stations. Any Electric Inspector may examine and record these readings at such times and in such manner as the authority appointing him may direct (Clauses 39 and 40), and he has right of access at all reasonable hours to the testing places and premises of the undertakers, for the purpose of testing their lines and instruments, and ascertaining if they are in order, and if not, he may require them to be put in order forthwith (Clause 41).

* If the undertakers are the Local Authority, Inspectors are appointed and their duties regulated by the Board of Trade, and the Local Authority have to pay such salaries as the Board may prescribe, in which case the fees will go to the local rate. In the County of London the County Council have the appointment and control of Electric Inspectors instead of the Local Authority, and the words in italics do not apply. In the parish of Chelsea, however, the Local Authority have retained the power of appointment, under the Chelsea Electric Lighting Order, 1886, and the new Cadogan and Belgrave Electric Lighting Order, 1891.

† Any particular portion of a main is not to be tested oftener than once in three months without a special order of the Board of Trade.

‡ If the Local Authority are the undertakers, this is settled by a Court of Summary Jurisdiction upon the application of ten consumers.

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The undertakers' representative may be present at all tests and inspections, but may not interfere therein (Clause 42).

A report of the test is to be made on the following day to the undertakers and the party requiring the same, and is to be received in evidence. Either party may appeal against it to the Board of Trade, whose decision is final (Clause 44).

The Inspector's fees and reasonable expenses are to be paid by the undertakers, unless his report, or the Board of Trade, decides that the consumer is at fault, when the latter is to pay (Clause 45).

Default by undertakers to afford all facilities for the execution of the above provisions, or otherwise in complying therewith, involves a penalty of £5, and £1 daily penalty (Clause 43).

CHAPTER IV.

Rights of the Public to Obtain Supply, and their Obligations in Connection Therewith.

It is enacted by (1882) § 19, that everyone within the undertakers' area shall be entitled to a supply of electricity upon the same terms, "except in so far as is otherwise provided by the License, Order, or special Act." Section 6 (*a*) also provides for regulations being inserted with regard to "the limits within which and the conditions upon which the supply is to be compulsory or permissive." By virtue of these sections full provisions on the subject have been inserted in the Model Order, which must be taken to be substituted for the more sweeping obligation that would otherwise exist under Section 19. These provisions are as follows:—

A.—*Compulsory Distributing Mains to be Laid* (Clauses 19 to 24).

Undertakers must within two years lay suitable and sufficient distributing mains for the purpose of general supply throughout certain scheduled streets. At any time after the first 18 months, they may also be required to lay such mains in every other street within their area, upon the following conditions being complied with. A requisition in a form to be supplied gratis by the undertakers must be served upon them by six* or more owners or occupiers in the street specified, or by the Local Authority controlling public lamps therein. In the former case, if the undertakers within 14 days after service so demand, the requisitionists must within 14 days after such demand, or after an arbitrator's award if the demand is disputed, guarantee that such supply shall be taken for three* years, as will at current charges to ordinary consumers pay a reasonable annual sum, to be specified in the demand, and must also, if the demand so requires, give security for payment thereof. Disputes as to the reasonableness of the sum or security demanded are to be settled by arbitration, but the annual sum demanded is not without the authority of the Board of Trade to exceed† "20 per cent. upon the expense of providing and laying down the required distributing mains, and any other mains or additions to existing mains which may be necessary for the purpose of connecting such distributing mains with the nearest available source of supply." The Board of Trade, on

* Under the County of London Form only two persons need join in the requisition, and the period of guarantee is two years.

† The Orders granted in 1889 contemplate an annual sum "not less than 20 per cent.," instead of "not exceeding 20 per cent."

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application by the undertakers within 14 days from service of the requisition, may absolve them altogether from the obligation to lay a main, or may vary the terms if the Board consider the circumstances render the requisition unreasonable. In the latter case the undertakers' demand above-mentioned may be served within 14 days from the Board's decision. If the requisition relates to a private street, which the undertakers are not authorised to break up, they must apply to the Board of Trade for leave to break it up under (1882) § 13, and if leave is refused the requisition is not binding. A Local Authority must, within 14 days after serving such a requisition, tender an agreement to take a supply for three years for such lamps in the street as they control. The mains must be laid within six months of the above formalities being completed.

When undertakers (not being the Local Authority) propose to lay a line in any street for supplying a particular consumer, and not for general supply, they must give 28 days' notice to the Local Authority and all persons whose premises such line will pass. Thereupon if two or more of such persons so require, in accordance with the provisions above stated, the undertakers must lay a distributing main.

B.—*Right of Consumers to obtain Supply.*

Any owner or occupier within 50 yards of a distributing main may require the undertakers "to give and continue" a supply to his premises, by serving them with a notice specifying the premises, the maximum power to be supplied, and a reasonable date for commencement of the supply. The undertakers must thereupon lay the necessary lines, but the consumer must pay the cost of the lines laid upon his property, and of so much outside it as exceeds 60ft. from the main. He must also contract for two* years' supply of a sufficient amount to pay at least 20 per cent. per annum on the undertakers' outlay on such lines, and find security† for such payment if required. The maximum power demanded must be reasonable, and must not be altered without a month's notice to the undertakers, and payment of all expenses consequent on such alteration. The undertakers may refuse to supply, unless reasonably satisfied that the consumer's fittings are in good condition, and may cut off the supply so long as the consumer uses it in such a way as to improperly interfere with the supply to others. Differences as to alleged defects in fittings, &c., improper use of the supply, what consumption may be reasonably anticipated on any premises, or the reasonableness of expenses under this heading, are to be settled by arbitration (Clauses 25 and 26). Also (1882) § 18, while forbidding undertakers to prescribe any particular form of lamp, provides against improper use of the supply.

C.—*Supply to Public Lamps.*

Undertakers must, on reasonable notice from the Local Authority, supply any public lamp within a distance of 75 yards from any distributing main (Clause 27).

* The Orders granted in 1889 here read "three years."

† In this and other cases where security is required to be given, either to or by undertakers, the amount and nature of the security, whether by deposit or otherwise, is, in default of agreement, to be settled by a Court of Summary Jurisdiction. In case of a deposit the parties to whom security is given must pay 4 per cent. [under the Orders of 1889 and 1890, the rate is 5 per cent.], interest on every sum of ten shillings deposited for every six months it remains in their hands (Clause 69).

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D.—*Penalties.*

Default in complying with obligations stated under A entails a penalty of £5* a day, and if the Board of Trade are of opinion in any case that such default is wilful and unreasonably prolonged, they may, after considering any representation by the Local Authority, revoke the Order as to the whole, or, with the consent of the undertakers, any part of the area of supply (Clause 21). The penalties under B and C are 40s. a day for every default as regards private consumers, and the same for each public lamp, the total penalties not to exceed £50 a day in respect of defaults not being wilful. No penalty is to be inflicted if the default is caused by inevitable accident or *force majeure*, or is of an unimportant character (Clause 28).

E.—*Regulations as to Supply.*

These are issued by the Board of Trade under (1882) § 6 and Clause 10 of the Model Order, and for the present are shortly as follows:—(For a complete copy *see* pages 112-119.)

(1.) One week before commencing supply through any feeding, charging, or distributing main, the undertakers must serve a notice on the Local Authority.

(2.) The supply is to be maintained constant, and sufficient for all consumers entitled. It may be discontinued for the purpose of testing at such intervals as the authority by whom inspectors are appointed may permit, and for any other purposes connected with the efficient working of the undertaking at such intervals as the Board of Trade may think expedient. Notice of such discontinuance and its probable continuance is to be served on the Local Authority.

(3.) Distributing mains must be so arranged that if any portion be interrupted for more than an hour, not more than 200,000 watts will be stopped, or 80 consumers affected. Reasonable notice of stoppage is to be given to consumers.

(4.) A constant "standard pressure" is to be maintained in the mains which may be different for different portions. Variations from the standard must not exceed three per cent. in case of low pressure, or two per cent. of high pressure, and these changes must not be so *un*frequent as to cause unsteadiness.

(5.) Undertakers must give notice of the "standard pressure" for each pair of mains, and this is not to be altered without leave of the Local Authority, subject to an appeal to the Board of Trade.

(6.) Undertakers must declare a pressure at each consumer's terminals, which, unless otherwise agreed, must not be greater than 115 volts, nor less than 45 volts, and must not be altered except in consequence of an authorised alteration in the "standard pressure." In case of transformation on the consumer's premises, they must give a choice of two pressures, one approximately half the other.

(7.) Variations from the "declared pressure" must not exceed four per cent.

(8.) Penalty for breach of these regulations, £5, and a like daily penalty.

F.—*Method of Charging for Supply.*

It is laid down by (1882) § 20, that the undertakers shall not, in making any agreements for supply, show any undue preference, but, save as aforesaid, they may make such charges as may be agreed upon, not exceeding the limits of price imposed by the License, Order, or Special Act.

* This penalty does not apply if the undertakers are the Local Authority, but the Board of Trade may revoke the Order.

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The Model Order draws a distinction between "general supply," *i.e.*, the supply to ordinary consumers, and "supply to one or more consumers under special agreement" (Clause 2), and provides that, subject to the right of consumers to be charged according to one of the methods hereafter described, undertakers and consumers may make what agreements they please as to price and mode of charging (Clause 29).

The supply to ordinary consumers, unless they otherwise agree, is to be charged for in Board of Trade units,* to be ascertained by a certified meter (as defined under H), and measured either—

(1.) By the actual quantity of energy supplied, *i.e.*, the meter must measure such units directly; or

(2.) By the electrical quantity supplied, in which case the units are to be ascertained by the product of such quantity, and the "declared pressure" at the consumers' terminals.

(3.) By such other method as may for the time being be approved by the Board of Trade. Consumers may, however, object to any method but the first two.

Before commencing supply through any distributing main, undertakers must give notice to the Local Authority by what method they propose to charge for supply through that main. They must give a month's notice, both to the Local Authority and every consumer supplied from it, before changing the method (Clause 29), and also (Clause 55) pay consumers' reasonable expenses, if a change of meter is involved.

Under the County of London Form, the **Maximum Price** is 13s. 4d. per quarter for any quantity up to 20 units, and beyond that 8d. per unit; but the Board of Trade may, on the application of the London County Council, or the Local Authority, or the undertakers, revise these prices, or the method of charging, every seven years, dating from August 26, 1889. The rule for the Provinces is the same, except that the seven year periods run from the commencement of the Order, but the Board of Trade will allow a different maximum, if special grounds are shown (Clause 30).

The price for public lamps is to be settled by agreement with the Local Authority, or failing that, by arbitration, regard being had to the circumstances of the case, the distributing mains which have been laid for the purpose, and the prices charged to ordinary consumers in the district (Clause 32).

G.— *Recovery of Charges and Security for the same.*

Charges for supply, or for meters or fittings, may be recovered summarily as a civil debt, but not as a penalty, the terms of Section 40 of the Gasworks Clauses Act, 1871, being limited in this respect by (1882) § 12. The matter would therefore be dealt with under the Summary Jurisdiction Act, 1879. Arrears due from an outgoing tenant cannot be recovered from the incoming tenant, unless the two tenants have so agreed (Gasworks Clauses Act, 1871, Section 39). Under (1882) § 21, the supply may be cut off until arrears, with expenses of cutting off, are paid.

* This unit is defined as the energy contained in a current of 1,000 amperes flowing under an E.M.F. of one volt during one hour.

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A consumer's supply may also be cut off under Clause 25, if he neglects to give security for his future payments, for seven days after notice from the undertakers requiring him to do so.

H.—*Meters, &c.*

A "**certified meter**" is defined by Clause 47 as a meter certified by an Electric Inspector to be a correct meter, and to be of some pattern, and to have been fixed and connected with the service lines in some manner, approved by the Board of Trade. If the meter is altered, unfixed, or disconnected, it ceases to be "a certified meter" until re-certified.

Undertakers must, if required by a consumer, supply, fix, and connect an appropriate meter, and get it certified, but may require prepayment of a reasonable price for the meter, or security to be given, or a hire* agreement entered into. Unless otherwise agreed, they are to keep a hired meter in repair at their own expense. They have no power to prescribe any particular form of meter, but, subject to the above provisions, consumers may use what meters they please. Undertakers may, however (*see* Clause 56), place a second meter at their own expense upon the consumer's premises, being of a pattern and fixed and connected in a manner approved by the Board of Trade. This, except by agreement, can only be placed between the mains and the terminals of the consumer's premises.

Consumers must not connect or disconnect any meter to be used as aforesaid without 48 hours' notice to the undertakers, under penalty of 40s. (Clause 50). They must keep their own meters in proper order at their own expense, otherwise the supply may be cut off. The expenses of taking off, removing, testing, inspecting and replacing such a meter, and procuring it to be re-certified, are to be paid by the consumer, if it is out of order, otherwise by the undertakers (Clause 51).

Every **Electric Inspector must** when required by the undertakers or any consumer, and on payment of the prescribed fee, examine any meter and certify the same, if he considers it entitled to be so certified (Clause 48). He is to settle differences between undertakers and consumers as to a meter being in proper order, or as to the value of the supply, and may order by whom the costs of proceedings before him are to be paid. His decision is final. Subject, as aforesaid, the register of the meter is to be conclusive evidence, in the absence of fraud, of the value of the supply. If the Local Authority are the consumers in question, then a Board of Trade Inspector is to decide (Clause 54).

I.—*Rights of Entry on Consumers' Premises.*

The right of entry upon consumers' premises is given to undertakers by (1882) § 24 at all reasonable times, to inspect, fix, connect, test, take off, or replace lines, meters, accumulators, fittings, works, and apparatus belonging to them, and to ascertain the quantity consumed or to cut off the supply and remove their property, they making good all damage caused thereby. (*See* also Clause 51.) They have also a right (under No. 23 of the Board of Trade Safety Regulations) to enter a consumer's premises after giving an hour's notice if they are reasonably satisfied that an earth connection exists there such as to be a source of danger.

* Power to let meters and fittings thereto for hire is specially granted by Clause 52.

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CHAPTER V.

POSITION OF LOCAL AUTHORITIES, COUNTY COUNCILS, AND THE POSTMASTER-GENERAL

A.—*Local Authority.*

This term is **defined** by (1882) § 31, and the Schedule to the Act. It means in the City of London the Commissioners of Sewers; in the rest of the Metropolis the Vestries or District Boards, except as regards such parts as the late Metropolitan Board of Works were authorised to light, for which the London County Council have become the Local Authority. In the remainder of England and Wales, and in Ireland, the Urban and Rural Authorities are indicated. In Scotland, under the Schedule to the Electric Lighting (Scotland) Act, 1890, in places within the jurisdiction of Police Commissioners, these Commissioners, the Town Council, or the Gas Commissioners are the Local Authority according to circumstances; elsewhere the County Council.

The same Schedules also define the term "Local Rate" for each case.

The **rights and powers of Local Authorities,** with respect to undertakings within their jurisdiction, have been stated in the preceding chapters, and it remains only to add something as to their position on becoming **themselves undertakers,** which they may do, either under a License (1882) § 3, or a Provisional Order (1882) § 4. They can acquire these powers (1) by original grant, in which case under (1882) § 3, sub-section 6, a resolution must be passed at a special meeting, held after a month's previous notice, or (2) by compulsory purchase, taking effect either at the expiration of the period limited in the Vendors' Provisional Order, or upon revocation thereof.

They have the following **special advantages over other undertakers.**

As regards Application for powers they are practically in sole possession of the field; since, besides the statutory requirements as to their consent to other applications, the Board of Trade will, except under special circumstances, always prefer them to other applicants. (*See* Note at the end of Board of Trade Rules.)

As regards Finance, they may apply the Local Rate to pay the expenses of their own application, and of their opposition to others (1882) § 7, also to afford security* for borrowed capital (1882) § 8, and to meet any deficiency of income (Model Order Form, No. 1, Clause 52). No deposit or security is required of them, and although their powers are liable to be revoked for neglect to lay compulsory mains, no pecuniary penalty can be exacted for default in this respect. Also their maximum rate of charge is not liable to revision every seven years.

Finally, they are not precluded from supplying outside their own area, nor forbidden to acquire other undertakings, whilst the facilities afforded of transferring their own will enable them to sell or farm out their statutory powers with advantage. This **power to transfer their powers, duties and liabilities,** is given by Clause 59 of Form No. 1, subject to the consent of the Board of Trade. One month before the draft deed of transfer is submitted to the Board, advertisements must be issued giving particulars of the proposed transfer, and stating where copies of the draft can be obtained at a charge of 6d. each. If the transferees are guilty of default, such as might entail revocation of the Order, the Board may instead of revoking permit the Local Authority to resume the

* This is the more important when it is remembered that other undertakers can only mortgage their undertaking subject to the liability of revocation and compulsory purchase.

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undertaking, and any question thereupon arising between them and the transferees are to be settled by the Board. Default in supplying printed copies of the deed involves a penalty of £5, and a like daily penalty.

Surplus Revenue, after forming a reserve fund (if thought fit), not exceeding one-tenth of the capital expenditure, is to be applied to public improvements or reduction of loans, but any excess beyond 5 per cent. per annum on such capital expenditure is to be applied in reduction of the price of supply.

Under the County of London Form a Local Authority owning any **subway** may serve notice on undertakers requiring them to use the same for laying their lines, and after such notice the undertakers so served may not break up any street where there is a subway, and must pay a reasonable rent for the use thereof, to be settled by arbitration in default of agreement.

B.—*County Councils.*

It will have been seen that County Councils **are not Local Authorities**, except in Scotland and in that comparatively small part of London which the late Metropolitan Board of Works were authorised to light.

Except as regards audit of accounts, under Clause 8 of the Orders granted before 1892, or interference with streets or bridges repairable by the County, County Councils are not, as a rule, concerned in the affairs of undertakers.

An exceptional position has, however, been conceded to the London County Council, under the Model Order Form No. 3, with respect to the following matters:

They have the same rights as the Local Authority to receive notice from undertakers before changing their method of charging for supply, and to make representations to the Board of Trade with a view to revision of the maximum every seven years, also to receive notices required by the Board of Trade Regulations when undertakers commence or discontinue supply through any main. Their rights over such streets and sewers as they are liable to repair are also protected in the same manner. They stand in the place of the Local Authority under the clauses which deal with the prohibition of lines above ground, the appointment and direction of Electric Inspectors,* and the consent required under the above Regulations to any suspension of supply or alteration in the "standard pressure."

C.—*Postmaster-General.*

It has been seen from the preceding pages that the Postmaster-General's lines are protected by various provisions mentioned in Chapter III., A, C, and E. He may also, under Clause 57, require undertakers, in addition to the map of underground works to be kept for public inspection, to furnish him with sections on such scale as the Board of Trade may prescribe, showing the levels of all such works.

The above provisions are declared by Clause 77 to be in addition to, and not in modification of, the provisions of the Electric Lighting Acts and the Telegraph Acts, 1863 to 1885; and although undertakers may have complied with all the requirements of the Postmaster-General under Clause 12 (*see* Chapter III., A), yet the concluding paragraph of that clause states that they will not be exempted from any legal penalty or obligation in case a telegraph line should be at any time injuriously affected.

* Subject to the exceptions stated in the note on page 103.

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(1882) § 35 precludes any Clause being inserted in a License or Provisional Order which would affect his **telegraphic monopoly.**

(1882) § 26 provides that none of his lines may be altered, except subject to the Telegraph Act, 1878, of which Sections 2 and 7 to 12 are incorporated; that undertakers must not lay any line or do other work which might injuriously affect the Postmaster-General's lines, either by induction or otherwise, or which come within ten yards thereof, without giving him not more than twenty-eight or less than seven clear days' notice, specifying the course and gauge of the proposed lines, and they must conform with his reasonable requirements, to be settled by arbitration in case of difference. Repairs and connections with mains, where the direction of the line to be laid crosses a line of the Postmaster-General at right angles at the nearest point, and so continues for six feet on each side thereof, are excepted from these provisions.

The penalties for breach are the same as those under the provisions stated in Chapter III., A, and a penalty of £50 a day is added for wilfully interrupting telegraphic communication. Undertakers are, however, absolved from penalties if the case was one of emergency, and they have given immediate notice at the nearest postal telegraph office, stating why they proceeded without the statutory notice.

Under the Telegraph Act, 1878, the Postmaster-General can give a counter-notice to the undertakers, stating either that he will do their work for them, or requiring them to proceed under his supervision. In either case they are to pay his expenses.

(1888) § 4 also gives the Postmaster-General jurisdiction over the electric lines of persons who are not undertakers under the Acts, and may require these to be used only in accordance with such conditions and regulations as he may prescribe, under penalty of £20 for neglect, and removal of the offending line upon the order of a Court of Summary Jurisdiction. Under the Board of Trade Regulations as to aerial conductors not erected by undertakers, mentioned in Part I., a plan of all such conductors must be lodged with the Postmaster-General, who may require alterations to be made, and all reasonable precautions must be used to prevent injurious affection of telegraph circuits by induction or otherwise.

[The foregoing DIGEST of the Electric Lighting Laws is published separately, together with the new Board of Trade Regulations, the London County Council Regulations as to Theatre Electric Lighting, &c.; price 2s. 6d., post free. Another book which may be usefully consulted is, "THE LAW RELATING TO ELECTRIC LIGHTING," written by Messrs. G. S. Bower and W. Webb, which deals fully and exhaustively with the subject, and has recently been entirely re-written; the price is 12s. 6d. For these amounts either book will be forwarded, post free, by "THE ELECTRICIAN" Printing and Publishing Company (Limited), Salisbury Court, Fleet Street, London, E.C.]

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THE BOARD OF TRADE REGULATIONS.*

THE following are the Regulations and Conditions for securing the safety of the public, and for ensuring a proper and sufficient supply of electrical energy, made by the Board of Trade under the provisions of the Electric Lighting Acts, 1882 and 1888. For the Regulations issued with Provincial Orders, the following alterations should be made :—

In No. 26 of the Safety Regulations for "35ft." read "30ft." In the Supply Regulations omit the words "County Council" where they occur in conjunction with "Local Authority," and where they occur alone substitute the words "Local Authority."

Definitions.

In the following regulations :—

The expression "the Order" means the ———— Lighting Order, ——.

The expression "the undertakers" means the undertakers for the purpose of the Order.

The expression "consumer" means any body or persons supplied or entitled to be supplied with energy by the undertakers.

The expression "consumer's terminals" means the ends of the electric lines situate upon any consumer's premises and belonging to him at which the supply of energy is delivered from the service lines.

The expression "consumer's wires" means any electric lines on a consumer's premises which are connected with the service lines of the undertakers at the consumer's terminals.

The expression "aerial conductor" means any conductor which is placed above ground and in the open air.

The expression "pressure" means the difference of electrical potential between any two conductors through which a supply of energy is given, or between any part of either conductor and the earth; pressure on any alternating-current system being taken to be the equivalent of pressure on a continuous-current system when it produces an equal heating effect if applied to the ends of a thin stretched wire or carbon filament; and

(*a*) Where the conditions of the supply are such that the pressure cannot at any time exceed 300 volts, if continuous, or the equivalent of 150 volts, if alternating, the supply shall be deemed a low-pressure supply;

(*b*) Where the conditions of the supply are such that the pressure may exceed the limits of a low-pressure supply, but cannot exceed 3,000 volts, or the equivalent of 3,000 volts, whether continuous or alternating, the supply shall be deemed a high-pressure supply;

(*c*) Where the conditions of the supply are such that the pressure may on either system exceed 3,000 volts, or the equivalent of 3,000 volts, the supply shall be deemed an extra high-pressure supply.

Mains, service lines, and other conductors and apparatus are referred to as low-pressure, high-pressure, and extra high-pressure mains, &c., according to the conditions of the supply delivered through the same, or particular portions thereof.

Provided that in the case of conductors laid under the surface of the ground in conduits, in accordance with these regulations, and being the property or under the sole charge of the undertakers, low-pressure conductor shall mean any conductor in which the pressure between that conductor and the earth cannot at any time if continuous exceed 300 volts, or if alternating, 150 volts, or between that conductor and any other conductor laid in the same conduit cannot at any time if continuous exceed 500 volts, or if alternating, 250 volts.

* These are now in course of revision. New Regulations will be issued early in 1894. The new Regulations will be added to the "Digest" of Electric Lighting Law, published annually in "THE ELECTRICIAN" Series.

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When any casing, support for conductors, conducting wire, or other metallic body is required to be efficiently connected to earth, it shall be deemed to be so connected when it is connected to metallic mains for water supply outside of buildings, or, where these are not available, to a mass of metal having a total surface of at least four square feet, buried to a depth of at least three feet in moist earth, by means of a conductor possessing a mechanical strength, and offering a passage to electrical discharges, equal to that of a strand of seven No. 16 galvanised iron wires.

The expression "daily penalty" means a penalty for each day on which any offence is continued after conviction thereof.

All other expressions to which meanings are assigned in the Order, or principal Act, have the same respective meanings in these regulations.

I.—Regulations as to Safety.

General.

1. *Low-Pressure Supply to Consumers.*—Save as hereinafter provided, the supply of energy delivered to the consumer's terminals shall be a low-pressure supply.

2. *Limitations of High-Pressure Supply.*—A high-pressure supply shall not be delivered to any consumer's terminals, except for special purposes, and with the approval of the Board of Trade on the joint application of the consumer and the undertakers, and subject to such further regulations as the Board of Trade may from time to time prescribe. But a high-pressure supply may be given to distributing or converting stations or points, or to distributing mains, in accordance with the following regulations.

3. *Limitations of Extra High-Pressure Supply.*—An extra high-pressure supply shall not be given except to distributing stations or other premises in the sole occupation of the undertakers, and with the written consent of the Board of Trade, and subject to such regulations and conditions as the Board may prescribe.

Mains and other Conductors.

4. *Maximum Current in Conductors.*—The maximum working current shall not be sufficient to raise the temperature of the conductors or any parts thereof to such an extent as to materially alter the physical condition or specific resistance of the insulating covering, if any, or in any case to raise such temperature to a greater extent than 30° Fahrenheit's thermometer; and efficient automatic means shall be provided which will render it impossible for this maximum working current by any accident to exceed such limit to the extent of 50 per centum, even for short intervals of time; and special care shall be taken that the cross sectional area and conductivity at joints are sufficient to avoid local heating, and that the joints are protected against corrosion.

5. *Lightning Protectors.*—Where any portions of any conductors are exposed in such a position as to be liable to be affected by lightning, they shall be efficiently protected against accidents by appliances of such pattern and construction as may from time to time be approved by the Board of Trade.

6. *High-Pressure Conductors Laid Above Ground.*—Where any high-pressure conductors, other than aerial conductors, are placed above the surface of the ground, they shall be completely enclosed in brickwork, masonry, or cement concrete, or in strong metal casing efficiently connected to earth.

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7. *High-Pressure Conductors Laid in Subways, &c.*—Where any high-pressure conductors are laid in subways, or in the same conduits with any low-pressure conductors, they shall be completely enclosed in strong metal casing efficiently connected to earth.

8. *High and Low Pressure Conductors Laid in Proximity.*—Where any high-pressure conductor is laid within a less distance than 18in. from any low-pressure conductor, or from the surface of the ground, or where any low-pressure conductor is laid within the above-mentioned distance from any previously laid high-pressure conductor, efficient means shall be taken to render it impossible that the low-pressure conductor or the surface of the ground shall become electrically charged by any leakage from or defect in the high-pressure conductor.

9. *Continuous Insulation.*—Every high-pressure conductor shall be continuously insulated with a durable and efficient material, which shall be protected on the outside against injury or removal by abrasion, and every such conductor shall be tested for insulation after having been laid in position, and before any joints for service lines are made. The insulation resistance under these conditions shall not be less in any section of the conductor than at the rate of 100,000 ohms per mile for every volt of pressure of the supply under a testing pressure of at least 100 volts, and the undertakers shall duly record the results of the tests of each conductor or section of a conductor, and at all times permit an electric inspector to examine and take copies of such record.

10. *Minimum Insulation Resistance Allowable; Indicator of Leakage.*—The insulation resistance of any complete circuit used for high-pressure supply, including all devices for producing, consuming, or measuring energy, connected to such circuit, shall be such that should any part of the circuit be put to earth through a resistance of 2,000 ohms, the leakage current shall not exceed 0·04 ampere in the case of continuous currents, or 0·02 ampere in the case of alternating currents. Every such circuit shall be fitted with an instrument of such pattern and construction as may from time to time be approved by the Board of Trade, which shall immediately indicate any defect which may at any time occur in the insulation resistance of either conductor.

Every such circuit shall be tested for insulation at least once in every week, and the undertakers shall duly record the results of such testings, and at all times permit an Electric Inspector to examine and take copies of such record.

11. *Precautions against Sparking with High-Pressure Alternating-Current Mains.*—In the case of a high-pressure supply on any alternating-current system, where separately-insulated conductors are laid in the same conduit, or pass through the same boxes, precautions shall be taken against the discharge of electric sparks between the insulating covering of oppositely charged conductors, by providing a sufficient connection of a conducting nature from one covering to the other throughout.

Conduits.

12. *Conduits to be Durable and Strong.*—All conduits used as receptacles for conductors shall be constructed of durable material, and of ample strength to resist any pressure due to heavy traffic or other forces to which they may be expected to be subjected.

13. *Conduits to be Kept Free from Water.*—Where the conductors in any conduit are not continuously insulated, adequate precautions shall be taken to insure that no accumulation of water shall take place in any part sufficient to raise the level of the water into contact with the conductors.

14. *Conduits to be Kept Free from Gas.*—All conduits for conductors constructed in streets in which gas mains are also laid shall be efficiently protected against an accumulation of gas.

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15. *Precautions with respect to Street Boxes.*—Where any street box contains high-pressure conductors, efficient means shall be taken to render it impossible that the covers or other exposed parts of these boxes, or any adjacent material forming the surface of the street, shall become electrically charged, whether by reason of leakage, defect, or otherwise; and all street boxes shall be efficiently protected against an accumulation of gas or water, and their covers so secured that they cannot be opened except by means of a special appliance.

Converting Stations.

16. *Converting Stations.*—Converting stations, or points in a system of distribution to which a high-pressure supply is given from generating stations, and from which a low-pressure supply is given to one or more consumers, and which are not on the consumer's premises, shall be established in suitable places, which are in the sole occupation and charge of the undertakers.

17. *Precautions against Contact.*—In every case where the supply is transformed at a converting station, as described in the preceding regulation, some means or apparatus approved by the Board of Trade shall be provided which shall render it impossible that the low-pressure distributing mains shall be at any time charged to a dangerous difference of potential from the earth, owing to any accidental contact with, or leakage from, the high-pressure system either within or without the converting station.

Consumers' Premises.

18. *Transformers and High-Pressure Apparatus to be Enclosed in Metal.*—Where the general supply of energy is a high-pressure supply, and transforming apparatus is installed on the consumer's premises, connected to the distributing mains by high-pressure service lines, and to the consumer's terminals by low-pressure service lines, the whole of the high-pressure service lines, conductors, and apparatus, including the transforming apparatus itself, so far as they shall be on the consumer's premises, shall be completely enclosed in solid walls, or in strong metal casing efficiently connected to earth, and securely fastened throughout.

19. *Precautions against Contact.*—In every case where any transforming apparatus is installed on the consumer's premises, as described in the preceding regulation, some means or apparatus approved by the Board of Trade shall be provided, which shall render it impossible that the low-pressure service lines and consumer's wires shall be at any time charged to a dangerous difference of potential from the earth, owing to any accidental contact with, or leakage from, the high-pressure system either within or without the transformer.

20. *Low-Pressure Apparatus to be Insulated.*—All terminals, low-pressure service lines, or other apparatus, between the transforming apparatus or other source of supply and the consumer's terminals, so far as they shall be on the consumer's premises, shall be completely enclosed in insulating cases, or coated with insulating material in such a manner that no part of them can be touched by any person without the removal of such case or coating, and, wherever exposed, shall be efficiently protected against injury to the insulation.

21. *Responsibility of Undertakers for their Lines, &c., on Consumer's Premises.*—The undertakers shall be responsible for all electric lines, fittings, and apparatus belonging to them, or under their control, which may be upon the consumer's premises, being maintained in a safe condition, and in all respects fit for supplying energy.

22. *Fire Risks.*—In delivering the energy to the consumer's terminals, the undertakers shall exercise all due precautions so as to avoid risk of causing fire on the premises.

23. *Testing Consumer's Wires for Leakage by Undertakers.*—If the undertakers are reasonably satisfied, after making all proper examination, by testing or otherwise, that a connection with the earth exists at some part of a circuit, of such

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resistance as to be a source of danger, and that such connection does not exist at any part of the circuit belonging to the undertakers; then, and in such case, any officer of the undertakers, and duly authorised by them in writing, may, for the purpose of discovering whether such connection with the earth exists at any part of a circuit within, or upon, any consumer's premises, at all reasonable times, after giving one hour's notice of his intention to do so, enter any such premises and disconnect the consumer's wires from the service lines, and may require the consumer to permit him to inspect and test the wires and fittings belonging to the consumer and forming part of the circuit.

24. *Supply to be Discontinued.*—If on such testing the officer discovers that a connection exists between the consumer's wires and the earth, and that such connection has an electrical resistance not exceeding 5,000 ohms, or if the consumer does not give all due facilities for such inspection and testing, the undertakers shall forthwith discontinue the supply of energy to the premises in question, giving immediate notice of such discontinuance to the consumer, and shall not recommence such supply until they are reasonably satisfied that such connection with the earth has been removed.

Provided that in cases where the maximum power taken by any consumer exceeds 25,000 watts, the consumer's wires may be divided for the purposes of this testing into separate circuits, the insulation resistance of each of which shall exceed 5,000 ohms.

25. *Appeal to Electric Inspector.*—If any consumer is dissatisfied with the action of the undertakers either in discontinuing or in not recommencing the supply of energy to his premises, the wires and fittings of such consumer may, on his application, and on payment of the prescribed fee, be tested for the existence of connection with the earth by an Electric Inspector, or if no Electric Inspector has been appointed, by a person appointed by the Board of Trade.

This regulation shall be indorsed on every notice given under the provisions of the last preceding regulation.

Regulations as to Aerial Conductors where Erected with Necessary Consents.

26. *Height from Ground and Distance from Buildings, &c.*—An aerial conductor shall not in any part thereof be at a less height from the ground than 20ft., or where it crosses a street 35ft., or within 7ft. of any building or erection other than a support for the conductor, except where brought into a building for the purpose of supply.

27. *Service Lines from Aerial Conductors.*—Service lines from aerial conductors shall be led as directly as possible to insulators firmly attached to some portion of the consumer's premises which is not accessible to any person without the use of a ladder or other special appliance, and from this point of attachment to the consumer's terminals they shall be enclosed and protected in accordance with the preceding regulations as to service lines on the consumer's premises.

28. *Maximum Intervals between Supports.*—Every aerial conductor shall be attached to supports at intervals not exceeding 200ft. where the direction of the conductor is straight, or 150ft. where this direction is curved, or where the conductor makes a horizontal angle at the point of support.

29. *Supports, Construction and Erection of.*—Every support of aerial conductors shall be of a durable material, and properly stayed against forces due to wind pressure, change of direction of the conductors, or unequal lengths of span, and the conductors and suspending wires (if any) shall be securely attached to insulators fixed to the supports. The factor of safety for the conductors and sus-

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pending wires shall be at least six, and for all other parts of the structure at least twelve, taking the maximum possible wind pressure at 50 pounds per square foot. No addition need be made for a possible accumulation of snow.

30. *Connection of Support to Earth.*—Every support, if of metal, shall be efficiently connected to earth, and if of wood or other non-conducting material, shall be protected by a lightning conductor fastened to the support along its entire length, and projecting above the support to a height of at least six inches, such lightning conductor being efficiently connected to earth.

31. *Angle of Crossing Thoroughfares.*—Where any aerial conductor crosses a street, the angle between such conductor and the direction of the street at the place of such crossing, shall not be less than 60 degrees, and the spans shall be as short as possible.

32. *Crossing other Wires.*—Where any aerial conductor belonging to the undertakers is erected so as to cross any other aerial conductor or any suspended wire used for purposes other than the supply of energy, precautions shall be taken by the undertakers against the possibility of their conductor coming into contact with such other conductor or wire, or of such other conductor or wire coming into contact with their conductor by breakage or otherwise.

33. *High-Pressure Conductors to be Insulated.*—Every high-pressure aerial conductor shall be continuously insulated with a durable and efficient material to be approved by the Board of Trade, to a thickness of not less than one-tenth part of an inch; and in cases where the extreme difference of potential in the circuit exceeds 2,000 volts, the thickness of insulation shall not be less in inches or parts of an inch than the number obtained by dividing the number expressing the volts by 20,000. This insulation shall be further efficiently protected on the outside against injury or removal by abrasion. If this protection be wholly or partly metallic it shall be efficiently connected to earth.

34. *Specification of Insulation.*—The material used for insulating any high-pressure aerial conductor shall be such as will not be liable to injurious change of physical structure or condition when exposed to any temperature between the limits of 0° and 150° Fahr., or to contact with the ordinary atmosphere of towns or manufacturing districts.

35. *Suspension of Conductors.*—Every aerial high-pressure conductor shall be efficiently suspended by means of non-metallic ligaments to suspending wires, so that the weight of the conductor does not produce in it any sensible stress in the direction of its length; and the insulated conductors and suspending wires, where attached to supports, shall be in contact only with material of highly insulating quality, and shall be so attached and guarded, that in case they break away it shall not be possible for them to fall away clear of the support.

36. *Undertakers Responsible for Supports.*—The undertakers shall be responsible for the efficiency of every support to which their aerial conductors are attached, and every such support shall be marked to indicate the ownership of the conductor.

37. *Maintenance.*—Every aerial conductor belonging to the undertakers, including its supports and all the structural parts and electrical appliances and devices belonging to or connected with it, shall be duly and efficiently supervised and maintained as regards both electrical and mechanical conditions.

38. *Unused Conductors to be Removed.*—The undertakers shall not permit any aerial conductor to remain erected after it has ceased to be used for the supply of energy, unless they intend within a reasonable time again to take it into use.

39. *Penalties.*—If the undertakers make default in complying with any of the preceding regulations they shall be liable to a penalty not exceeding £10 for every such default, and to a daily penalty not exceeding £10.

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The imposition of any penalty under this regulation shall not affect the liability of the undertakers to make compensation in respect of any damage or injury which may be caused by reason of such default.

II.—Regulations as to Supply.

1. *Notice of Intention to Supply Through Mains.*—One week at least before th undertakers are ready to commence to supply energy through any feeding, charging, or distributing mains, they shall serve a notice upon the County Council and the Local Authority of their intention to commence such supply.

2. *Undertakers to Provide Constant Supply.*—From and after the time when the undertakers commence to supply energy through any distributing mains, they shall maintain a supply of sufficient power for the use of all the consumers for the time being entitled to be supplied from such main; and such supply shall, except so far as may be otherwise agreed upon from time to time between the County Council and the undertakers, be constantly maintained at such pressure as may be fixed under the provisions of these regulations. Provided that, for the purposes of testing, the authority by whom the Electric Inspector is appointed may give permission to the undertakers to discontinue the supply at such intervals of time and for such periods as it may think expedient, and that for any other purposes connected with the efficient working of the undertaking, the undertakers may, with the permission of the Board of Trade, discontinue the supply at such intervals of time and for such periods as the Board of Trade may think expedient. Where the supply is so discontinued notice of such discontinuance, and of the probable duration thereof, shall be forthwith served upon the County Council and the Local Authority.

3. *Maximum Supply from One Section of Main.*—The system of distributing mains shall be so arranged in sections that in case it becomes necessary to stop the supply through any portion of a main for more than one hour, for the purposes of repairs, or for any other reason, the stoppage of supply will in no case exceed in amount a maximum power of 200,000 watts, or extend to the premises of more than 80 consumers, and in the case of every stoppage for more than one hour reasonable notice shall be previously given by the undertakers to every consumer affected thereby except in cases of emergency.

4. *Pressure in Mains during Supply.*—During the whole of the period when a supply of energy is required to be maintained by the undertakers in the distributing mains under the Order and these Regulations, it shall be maintained at a constant pressure (in these Regulations termed "the standard pressure") to be fixed as hereinafter specified; but such standard pressure may be different for different portions of the distributing mains. Provided that the undertakers shall be deemed to have complied with the requirements of this regulation so long as the pressure does not at any point vary more than 3 per cent. from the corresponding standard pressure, in the case of a general supply at low pressure, or 2 per cent. in the case of a general supply at high pressure, unless changes in pressure recur so frequently as to cause unsteadiness in the supply.

5. *Fixing of Standard Pressure.*—The standard pressure shall be fixed by the undertakers for every pair of distributing mains, and notice of the amount of such standard pressure shall be given to the County Council before the undertakers commence to supply energy to consumers through such mains, and such standard pressure shall not be altered except by permission of the County Council, and upon such terms and conditions as the County Council may impose, and after public notice has been given during a period of one month in such manner as the

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County Council may require, of the intention of the undertakers to apply for permission to alter the same. The undertakers may appeal against any decision of the County Council under this regulation to the Board of Trade, whose decision shall be final.

6. *Declared Pressure at Consumer's Terminals.*—Before commencing to give a supply of energy to any consumer, the undertakers shall declare to such consumer the constant pressure at which they propose to supply energy at his terminals. The pressure so declared at any pair of consumer's terminals shall not, except by agreement, be greater than 115 volts or less than 45 volts, if continuous, or the equivalents thereof respectively, if alternating, and shall not at any time be altered or departed from except in consequence of any authorised alteration of the corresponding standard pressure. In distribution on the three-wire system, the central terminal shall for the purposes of this regulation be considered to form a pair with either of the outer terminals, and similarly for multiple-wire systems; and, in the case of a transformation of energy on the consumer's premises, the undertakers shall give the consumer the choice of a supply at either of two different pressures, one of which shall be approximately half the other, and in such case the pressure so chosen by the consumer shall be the declared constant pressure.

7. *Variation of Pressure at Consumer's Terminals.*—The variation of pressure at any consumer's terminals shall not under any conditions of the supply which the consumer is entitled to receive, nor at any time, exceed four per centum from the declared constant pressure, whether such variation be due to the resistance of the service lines or apparatus belonging to the undertakers, or to any action or effect produced by such apparatus, for which the consumer cannot be shown to be responsible, or, partly to any variation of pressure in the distributing mains from which the supply is taken.

8. *Penalty for Default.*—If the undertakers make default in complying with any of these regulations as to supply, they shall, subject to the provisions of the Order, be liable to a penalty not exceeding £5 for every such default, and to a daily penalty not exceeding £5.

These Regulations are made subject to the power of the Board of Trade to make such further or other Regulations as they may think expedient; and nothing in these Regulations shall be construed to authorise the undertakers to lay any electric line or work their undertaking otherwise than in accordance with the Order and the principal Act, or to supply energy otherwise than by a system for the time being approved of by the Board of Trade under the Order.

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THE LONDON COUNTY COUNCIL REGULATIONS AS TO THEATRE LIGHTING.

The following rules and regulations with regard to the electric lighting of theatres and other places of entertainment in their jurisdiction have been adopted by the London County Council:—

Where the electric light is permitted in such premises, it shall be on condition that a competent electrical engineer do certify in writing to the satisfaction of the Council once in six months that the system is in proper working order.

1. All such premises when lighted by electric light shall have at least three separate and distinct circuits (*a*) for the stage, (*b*) and (*c*) for the auditorium, corridors, and exits. The circuits referred to in (*b*) and (*c*) shall be so arranged that half the lights in each division of the auditorium and half those in each corridor and exit shall be on (*b*) and the other half on (*c*) circuit. When the current is supplied by a public lighting company, these circuits shall be taken separately from the street mains.

Under all circumstances complete metallic circuits must be employed. Gas and water pipes shall never form part of any circuit.

The number of lamps shall be so subdivided that no sub-circuit shall carry more than 65 amperes, and each sub-circuit shall start from a distributing board.

2. All conductors used within buildings shall be of copper, having a conductivity equal to not less than 98 per cent. of that of pure copper, and shall be so proportioned to the work they have to do that, if double the normal current be transmitted, their temperature shall not rise to above 150°F.

The conductors shall be insulated with pure and vulcanised india-rubber. The insulation resistance shall not be less than 300 megohms per statute mile, at 60°F., after one minute's electrification, when tested with at least 400 volts, and after 48 hours' immersion in water. The insulated conductors shall be protected on the outside by stout tape or braiding impregnated with preservative compound.

If it is desired to use any other means of insulation than that above specified, special permission shall be obtained from the Council, and no material shall be used which is not waterproof, or which will soften at a temperature below 170°F.

In all cases conductors conveying currents of high E.M.F. inside buildings, shall be specially and exceptionally insulated, and cased in, and the casing made fireproof. The positive and negative terminals connected to such conductors shall not be nearer to each other than 12 inches, and shall be efficiently protected from risk of contact.

Flexible conductors in connection with movable lights shall be insulated with vulcanised india-rubber, and protected on the outside by a stout braiding; should any of these flexible conductors be damaged, it shall be at once replaced. No circuit of this nature shall carry more than 10 amperes, and each circuit shall be protected by a double pole fuse.

3. All conductors shall be efficiently protected from mechanical injury.

When conductors pass through walls, fireproof floors, or ceilings, they shall be protected by iron pipes or by glazed stoneware or porcelain tubes, and precautions shall be taken to prevent the possibility of fire or water passing along the course of the conductors.

In special cases, or where necessary for protection from the depredations of rats, mice, or other vermin, armoured cables may be used. These need receive no further mechanical protection.

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Lead-covered cables shall not be used unless protected by external armour of iron or steel.

Metal fastenings for fixing conductors shall be avoided; but when unavoidable some additional covering shall be used to protect the conductor, unless armoured, from mechanical injury at the points of support.

If casing be used it shall be of hard wood, and each conductor shall be laid in a separate groove; the cover shall be secured with screws. Casings shall, as far as possible, be placed in sight, and the conductors shall always be accessible.

Joints in conductors shall be avoided, but when unavoidable, they shall be electrically and mechanically perfect. Soldering fluids shall not be used in making such joints.

4. All external conductors shall be specially insulated and laid in iron pipes properly jointed, and of ample size. Such iron pipes shall be protected where necessary, and securely fixed and supported when not underground.

5. All exposed metal work, such as fittings, switch and fuse covers, &c., shall be efficiently insulated from the circuits.

All switches, cut-outs, ceiling roses, wall and floor sockets, and lampholders shall have uninflammable bases. All switches shall be of ample size to carry the currents for which they are intended without heating, and shall be so constructed that it will be impossible for them to remain in any position intermediate between the "on" and the "off" positions, or to permit of a permanent arc. All circuits shall be efficiently protected by cut-outs, placed in positions easily accessible to the staff, but inaccessible to the public. The main cut-outs shall be of such pattern and be fixed in such a position as to admit of quick replacement. All circuits carrying a current of 20 amperes or more shall be provided with a cut-out on each conductor, and the two cut-outs shall not come in the same compartment. All cut-outs shall be so constructed that fused metal in falling cannot cause a short circuit or an ignition. All cut-outs shall be so marked as to show what circuit or lamps they control. All wall or floor sockets shall be provided with fuses in their fixed portions. The sockets for the stage shall be of hard wood with metal guards, care being taken to avoid risk of ignition, and they shall be of specially substantial construction.

6. Resistances, for regulating the power of the lights, shall be mounted on incombustible bases, and shall be so protected, and placed at such a distance from any combustible material, that no part of the resistance, if broken, can fall on such material.

Principal resistances shall be placed in a fire-proof room reserved for the purpose.

7. Arc lamps shall not be used inside buildings without special permission from the Council.

When they are used, special precautions shall be taken to guard against danger from falling glass or incandescent particles of carbon. All parts of the lamps, lanterns, and fittings which are liable to be handled (except by the persons employed to trim them) shall be insulated.

8. Where there is a stage, special care shall be taken that all works in connection with the lighting of the stage are carried out in as substantial a manner as possible.

No metal work in connection with the circuits shall be exposed, or so fixed or constructed as to be liable to cause a short circuit.

Lamps on battens, footlights, &c., shall be protected by stiff wire guards, so arranged that no scenery or other inflammable material can come in contact with the lamps.

No readily combustible material shall be used in connection with any lamps on the stage in such a manner that it might come in contact with the lamps.

No soft or readily inflammable wood shall be used in connection with the lamps on the stage, and all wood shall be protected by uninflammable material

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from the possibility of ignition by an arc between any two parts of the two conductors, or by heated particles from any conductor or part of a conductor which may connect together the two main conductors.

Where a number of lights, as in the footlights, battens, &c., are supplied under control of one switch, and protected by one single or double pole cut-out, as the case may be, the conductors shall be maintained throughout of such a section that they will be efficiently protected by the cut-outs against heating.

The leads to the battens shall be specially guarded, particularly at the points where they join on to the battens, and a sufficient length shall be allowed to prevent the leads receiving any injury through any movement of the battens.

The battens shall be suspended by at least three wire ropes attached to insulators on the battens.

On no account shall the same battens be adapted for both gas and electric light.

9. A switchboard, containing all the necessary switches, cut-outs, and other fittings for the control and regulation of the stage lighting, shall be fixed in some convenient position overlooking the stage. This board shall be inaccessible to all but the persons employed at such premises to work it.

10. Boilers, steam engines, gas engines, and dynamos, when used for the supply of electricity to such premises, shall be placed in such positions as shall be sanctioned by the Council.

Gas engines shall be placed in rooms so adequately and continuously ventilated that no explosive mixture of gas can accumulate by any leakage through the engine in the event of any of the gas cocks being left turned on. A hood, connected with a pipe carried into the external air, shall be fixed over the ignition tube when this is used.

11. Primary or secondary batteries shall be placed in rooms so adequately ventilated that no fan shall be necessary. The batteries shall be well insulated.

12. Transformers used to transform either direct or alternating currents, together with the switches and cut-outs connected therewith, shall be placed in a fire and moisture proof structure. Where the primary current is of high potential, such structure should be preferably outside the building. No part of such apparatus shall be accessible except to the person in charge of its maintenance.

No transformer which, under normal conditions of load, heats above 130°F. shall be used.

Transformer circuits shall be so arranged that under no circumstances shall a contact between the primary and the secondary coils lead an E.M.F. of high pressure into the building. The term high pressure means in all cases pressure above 200 volts.

13. The insulation resistance of a system of distribution shall be such that the greatest leakage from any conductor to earth, when all branches are switched on, the lamps and motors being removed, shall not exceed one fifteen thousandth part of the total current intended for the supply of the said lamps and motors, the test being made at the usual working electromotive force, provided that this rule shall not be held to justify a lower insulation resistance than 5,000 ohms, nor require one higher than 5 megohms.

14. The generating plant and switching gear shall be in the hands of thoroughly competent manipulators, and the engine-room (if any) shall be inaccessible to the general public, and shall, where possible, have an independent entrance.

15. A plan of the wiring shall be always kept in a prominent position in the office of the manager of such premises.

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RULES AND REGULATIONS FOR THE PREVENTION OF FIRE RISKS ARISING FROM ELECTRIC LIGHTING, &c.

[The Fire Risk Rules included in these pages have been made the basis upon which Electric Lighting Risks are accepted in Great Britain, India, and nearly the whole of the British Colonies.]

WE have permission to extract the following from the rules issued by the Phœnix Fire Office:—These Rules were the first Electric Light Risk Rules issued, and were prepared by Mr. Musgrave Heaphy, C.E. They are accompanied by remarks by the author, setting out that deviations are allowed under certain circumstances, always provided that the consent of the Company's representative has first been obtained. The first edition of the Rules was published in February, 1882; they have now (January, 1894) reached the twenty-second edition.

RULE 1. Where practicable, all conductors in a building should be so placed as to be easily accessible, and capable of being thoroughly inspected whenever required. It is desirable, therefore, that conductors be not run out of sight, such as between floors and ceilings, under roofs, behind skirting-boards, wainscoting, &c., if it can be avoided.

RULE 2. All conductors to have sufficient sectional area, so as to allow at least 100 per cent. more electricity being safely sent through them than will ever possibly be required for the lights they are to supply. By safety is meant that there shall be no perceptible heating of the conductors to the touch; and when proportioning their sizes, the possibility of their sectional areas getting diminished by corrosion or mechanical injury, as time goes on, should never be forgotten; the importance of this cannot be overrated.

Under normal conditions for internal work, the quantity of current sent down a conductor must not exceed the ratio of 1,000 amperes per sectional square inch of copper, when the amount passing through the said conductor does not exceed 100 amperes; should the amount of current exceed 100 amperes, the ratio must, of course, be less. The conductors should be of copper, the conductivity of which should not be below 98 per cent. The use of copper, however, is not obligatory in all cases. All conductors of a larger sectional area than No. 16 S.W.G. should be composed of strands.

RULE 3. No naked conductor, or conductors, allowed in a building.

RULE 4. All conductors must be highly insulated with substantial coats of india-rubber of the highest quality, and which must be specially prepared to last, and which must be of approved thicknesses (or other specially approved equally good material or materials that will not too readily become plastic, that are impervious to moisture, and of lasting quality); and the insulation should be protected by strong and durable coverings, such as braided hemp, which should also be impervious to moisture. The insulation should be as uninflammable as practicable, so long as its efficiency or durability is not diminished thereby. The outer coat of india-rubber must be vulcanised, or treated in other specially approved manner, but that next the metallic conductor must be pure. The insulation on a conductor should be in the form of a homogeneous tube, and the insulation resistance of the conductor before fixing should not be less than 250 megohms per mile in dry places, and 600 megohms per mile in damp places.

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RULE 5. In non-hazardous risks, the conductors having been thoroughly well insulated (as described under Rule 4) should be enclosed in substantial wood casing, and the conductors kept apart by a continuous fillet or width of wood; and the fillet or width of wood should be $1\frac{1}{2}$ inches in breadth in the case of mains, 1 inch in breadth in that of the principal branches, and $\frac{1}{2}$ inch in breadth in that of the smallest branches. The casing should be composed of sound, hard, well-seasoned wood, although iron or other approved metal tubes may sometimes be used. There must be no crossing of wires in casing. Where the conductors are permitted to remain unenclosed, the mains should be kept from 4 to 6 inches, and the small branches at least 2 inches apart; and no conductor should be less than 2 inches from any other conductor, or conducting substance, unless special precautions against contact have been taken. Where external injury is possible, the conductors must be enclosed in hard wood, slate or other approved casing, or laid in cement troughing (dry), or securely placed in metal tubes (except under those circumstances where the use of metal tubing would not be desirable), or otherwise efficiently protected.

Where conductors are not enclosed, and when the electromotive force exceeds 220 volts with a continuous current, or 110 volts with an alternating current, the distance they should be kept apart from each other, and from all other conducting substances, ought to be at least 6 inches.

In hazardous risks, all conductors should be further protected. Having been thoroughly well insulated as before described, they might be laid in hard wood casing treated with an approved fire-proof paint or compound, and packed in with asbestos or silicate cotton or other approved material; or they might be laid in cement troughing, or in separate earthenware tubes (or separate metal tubes may be used when alternating currents are not employed). (For theatres and very hazardous risks see Rule 38.)

If the electromotive force exceeds 220 volts with a continuous current, or 110 volts with an alternating one, special precautions, varying according to the electromotive force employed and the surrounding conditions, may be required. Where the current is of extremely high electromotive force, then the conductors may have to be encased and kept apart as described in Rule 29, for the primary conductors carrying alternating currents to secondary generators.

The best rule to follow when laying the conductors, is to so arrange them, that they would still be practically insulated, in the event of their insulating coverings getting worn away, or removed.

RULE 6. Twin wires, where allowed, should be kept as free as possible from the vicinity of inflammable materials, be very carefully protected by cut-outs, their insulation should be as substantial as possible and be protected also as much as possible against abrasion; the wires should not be in positions where they could make an earth. Too much attention cannot be bestowed upon this rule.

RULE 7. All conductors in buildings passing between floors and ceilings, under roofs, behind wainscoting, through partitions, or otherwise out of sight, must, where practicable, be enclosed in wood or earthenware casing, or laid in cement troughing, or in separate earthenware (or approved metal) tubes, in the manner described under Rule 5. No conductor carrying an alternating current of over 110 volts, nor any conductor carrying an alternating current that forms part of a three-wire system, the electromotive force of which between the first and third conductors exceeds 210 volts, should be laid out of sight.

RULE 8. All conductors in a building that are exposed to moisture must have waterproof insulation. All casings, under similar conditions, in or about a building must be made waterproof. A contractor should not be required to do electrical work in a building not thoroughly "dry."

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RULE 9. External conductors attached to a building must be insulated, and the insulation must be of a waterproof and durable character calculated to resist deterioration from atmospheric influences.

RULE 10. Conductors should never pass through party walls separating two risks. If conductors are carried up lifts, special precautions may in some cases be required.

RULE 11. All conductors passing through the exterior walls of buildings must be insulated and enclosed in separate earthenware (or approved metal) tubes, or laid in a suitable cement, in the manner described under Rule 5. The arrangement must be such as not only to prevent moisture entering, but also fire penetrating from the outside by running along the conductors.

RULE 12. When two conductors are joined together, the junction must be soldered. Rosin should be used when soldering.

RULE 13. Wherever a branch is led off any conductor to supply current for one or more incandescent lamps, or for any other purpose, a short length of lead, tin, or other fusible metal or substance, must be inserted at the junction of the branch with the conductor, or as close thereto as possible, and should be of such section, length, and nature that, if the current passing through it exceeds the normal current by 50 per cent., then it will fuse and disconnect the branch. When the normal current sent down a small wire does not reach half the safe-carrying capacity of the said branch, then the cut-outs may be arranged to fuse at a higher percentage, provided such amount of current does not exceed 100 per cent. of the normal current of the small wire, and that the margin of safety is not lessened thereby. All principal branches, and branches having a considerable number of lights, must have cut-outs on both poles. Small branches, taken off conductors of much larger size, and the branches supplying current to fittings containing several lights, should have cut-outs on both poles. When the current is derived from a central station, or from accumulators, no branch carrying four amperes or upwards should be without cut-outs on both poles. Cut-outs should never be placed under floors, inside roofs, or behind wainscoting, or skirting-boards, or in wood cupboards. They should be so arranged and mounted that no danger could arise in the event of their heating or fusing. If any conductor, by re-uniting with any other conductor, or by any other arrangement, becomes technically part of the main or otherwise, it will still be considered as a branch if its sectional area is less than the conductor it issues from, and must be protected as such. The mains themselves, both positive and negative, must be protected by cut-outs, which should be placed as near the dynamo (or source of electricity) as possible. When lights are grouped, as upon electroliers, &c., care must be taken that the last controlling cut-out shall act before the smallest wire runs any risk of getting unduly heated. When an incandescent installation is arranged on the "multiple circuit" system, with distributing switch and cut-out boards, the ultimate distributing circuits should carry as small an amount of current as possible—not more than from 4 to 5 amperes. With regard to arc circuits, or when incandescent lamps are arranged in series, the question as to whether fusible "cut-outs," or what other kind of "cut-outs," should or should not be used, must be decided as each particular case arises.

RULE 14. The fastenings of conductors should be composed of a non-conducting material. When conductors are not encased, they should be fastened to porcelain or earthenware insulators. Where metal staples are used a piece of some approved insulating should be inserted between the head of the staple and the insulation of the conductor; saddles or wood cleats should, however, be used in preference to metal staples.

RULE 15. No earth return allowed.

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RULE 16. House mains and all the principal branches when the current is supplied from a central station or from accumulators to have switches on both poles. The arrangement should be such that the current can be entirely cut off from the lights in any portion of the building the occupier may desire. All the principal portions of a building, therefore, should be controlled by double switches. All switches to be of such construction and make that they will not be liable after short use to get out of order and heat or fire. Their construction should also be such that it would be impossible for them to remain in any intermediate position between full-on and off. All switches must be mounted and placed in such a secure manner that no danger can arise in the event of their heating. They must also be so mounted that leakage of electricity from them is rendered impossible. Switches inside buildings must always have an incombustible base, the insulation of which should be perfect. No metal work carrying current should be exposed at the underside of the base. The cover should be incombustible, and they should be kept perfectly free from moisture. Switches contained in lamp sockets will only be allowed where permission to use them has been obtained. Where practicable every room and every passage should be controlled by a separate switch. The current carried by the last controlling switch should not exceed 6 amperes.

RULE 17. A switch and a cut-out on each conductor should be placed outside a building at or near the entrance of the conductors, when the electricity is generated externally. When switches and cut-outs cannot satisfactorily be placed outside a building, they must be fixed inside at the entrance of the conductors into the building, in accessible positions. When the building is in the occupancy of various tenants, each tenant must have a double switch and double cut-outs at the points of entrance of the conductors into his tenancy (preferably on the outside). When the source of supply is internal, a switch and a cut-out should be placed on each conductor in the dynamo-room.

RULE 18. Switch-boards should be composed of a non-conducting fireproof material, and they should be in a dry and secure place, and be most carefully fixed and mounted, and the arrangement of the conductors at the back should, if possible, be such, that if on fire, the fire could not spread to the rest of the installation. It is preferable for switch-boards to be "split," *i.e.*, the positive portion separated from the negative part. All switch-boards should have an oak, teak, or mahogany frame with glass front.

RULE 19. Resistances, bare or other connections, lamps, &c., must be so mounted that no danger could arise in the event of their heating, and that leakage of electricity from them is impossible. Resistances must be mounted on an incombustible material, and kept well away from inflammable materials.

RULE 20. Inflammable materials must be kept at a perfectly safe distance from incandescent lamps, which sometimes get exceedingly hot.

RULE 21. No naked lights allowed. If arc lights are used, they must be furnished with globes, which must be enclosed at the base, and so arranged at the top that no sparks or flame can escape. The globes must be covered round with wire netting. When arc lights are run in series, means must be taken for maintaining the constancy of the current, whatever number of lamps may be burning.

RULE 22. All lamp-holders must be incombustible, and of an approved type. The ends of flexible wire, when composed of fine strands, should be soldered before being attached to holders. All ceiling roses should be composed of an incombustible material, and be most carefully made and fixed. They should be fastened to back blocks. Wall sockets must also be composed of an incombustible material, and the greatest care exercised in fixing them.

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RULE 23. Electroliers should be fastened to an insulating block, which should be separately fixed to the wall or ceiling. Each electrolier should be protected by cut-outs.

RULE 24. Gas fittings and electric light work should be kept quite distinct from each other. Gas fittings must never be utilised for the electric light, unless specially made for the purpose, and are so arranged that it would be impossible for them to be the means of an "earth" being set up.

RULE 25. Concentric conductors may be used under certain circumstances, but all joints and connections must be so made that freedom from undue heating is absolutely secured; and the outer conductor must be so securely protected that all danger from injury, corrosion or other causes (electrical or otherwise) is effectually prevented, while precautions must be taken to prevent the conductors being affected by moisture.

The insulation resistance between the internal wire and the return of a concentric conductor before being placed up should not be less than 250 megohms per mile; the electromotive force of the current not exceeding 210 volts. The internal wire should be positive, if possible. The insulation must be impervious to moisture, of approved thickness, and have two approved metallic envelopes (the first one forming the return conductor, the second one forming the "guard"); these, except when the system is earthed, must be insulated from each other in such a manner that the internal wire and the return are insulated from each other. The "guard" must be an absolutely efficient protection against mechanical injury taking place to the return conductor, and be also an efficient protection against any accession of moisture to the insulation, especially when the sytem is earthed. The carrying capacity of the conductors must be at least equal to the ratio of that laid down for copper in Rule No. 2; if, however, a metal other than copper be used, the specific resistance of which is greater than that of copper, then the sectional areas of the conductors must be proportionally increased. All switches and cut-outs must be enclosed in approved fireproof boxes. No earth connection will be allowed to a gas pipe, or to lead or compo pipes. If any part of a concentric system be earthed, then the whole system must be concentric: unless permission to the contrary be given. Switches and cut-outs should always act on the internal (or live) wire when the system is earthed. The insulation resistance of the work when placed up must never be below that given in Rule No. 34 for general wiring. When the system is earthed the tests, of course, will refer to the pole that is unearthed.

RULE 26. No dynamo, motor, or any apparatus for generating electricity is to be placed in any working room of any cotton, woollen, flax, jute, or corn mill; or in any mill or factory of a like description; or in any working room or place where any hazardous process is carried on, or in which any hazardous goods are stored, or where there is special risk. The engine-room or mechanics' shop not considered as a "working room." Transformers and accumulators will come under this rule. Wherever a dynamo (or other apparatus for generating electricity) is placed, especial care should be taken to see that the dynamo be thoroughly well insulated from earth. The same rule must be observed with regard to motors and accumulators.

RULE 27. Where accumulators or primary batteries are used, the mains, both positive and negative, must have a switch and a cut-out upon each. The principal branches must also be protected in a similar manner. Accumulators must be kept where there is good ventilation. The conductors from the regulating cells of the accumulators to the regulating switch-board must be protected by cut-outs as close to the regulating cells as possible. It should be possible to turn off the current at the accumulators whenever required. The lug connections of accumulators should be periodically examined.

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RULE 28. An electrical power installation requires the same safeguards that apply to an electric light installation, in which the conditions of supply and the electromotive force of the current are similar.

RULE 29. When transformers (or secondary generators) are employed, and the alternating primary current is of high electromotive force, neither the transformer nor any portion of the primary work in connection therewith should be placed inside any building, but in a fireproof chamber apart. If this cannot conveniently be done, then the fireproof chamber may be placed inside the building, preferably against an external wall, so that the primary conductors may enter direct and not traverse any portion of the building.

The primary conductors must be heavily insulated with pure and vulcanised indiarubber of the highest quality, specially prepared to last (or other approved material), and must have a very strong external covering, and a very high insulation resistance. The conductors must be kept at a distance of 6 to 12 inches from each other, and be enclosed in separate casings of a non-conducting material, waterproof and fireproof, and these casings channelled into the brick or stone walls of the building; and the arrangement must be such that no leakage of electricity can take place to earth from either of the conductors, or any short circuit from one to the other. The primary conductors must be furnished with an interlocked double-pole switch, and also with a cut-out on both the lead and return, which will act at or below 25 per cent. above the normal current. The switch and cut-outs should be of such design and make that an arc in either of them could not be sustained—they should be placed as close as possible to the entrance of the primary conductors into the fireproof chamber. When permission has been given for primary conductors to enter a building before reaching the fireproof chamber, then the switch and cut-outs should be enclosed in fireproof boxes and placed in accessible and secure positions outside of the building; if they cannot be placed outside, then they must be situated in approved positions close to the entry of the primary conductors into the building. Switches must be so placed as to be readily accessible, in order that the primary current can at once be turned off. The whole of the primary work should be so situated and protected that it could not be tampered or interfered with by unauthorised persons, and the arrangements be such that no damage would result to the building if any portion heated or fired. This Rule insists that too much attention cannot be bestowed with regard to the placing of all portions of the primary work and the rendering of them safe and reliable. A transformer should be so constructed that a leak between the primary and secondary coils is rendered impossible, or for the primary current to pass into the secondary conductors; all secondary work must be protected by an approved automatic apparatus (or arrangement) at or near the transformer, so that in the event of the difference of potential between either secondary conductor and the earth rising at any time above 400 volts, then the apparatus will instantly act and cut off the current. The secondary work in the house should also be protected by an approved device, so arranged that in the event of the resistance to earth of any circuit falling below 1,000 ohms, then it would instantly act and cause the primary current to be at once cut off from the building. The primary current entering a house transformer ought never to exceed 2,500 volts. If, however, the current be generated higher than this, and reduced by means of transformers, then at each transformer, intermediate between the house transformer and the generating dynamo, there must be placed an approved automatic apparatus (or device) whereby the conductors leading from each transformer in the direction of the building to be supplied with current cannot possibly have their electromotive force raised more than 20 per cent. above the normal.

The secondary conductors must be highly insulated with at least two coats of indiarubber of the highest quality (the outer one must be vulcanised), of

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specially approved character, make, and thicknesses, and specially prepared to last, and they must have a very strong external waterproof covering; they should be furnished with switches and cut-outs on both poles, except in the case of small branches, when single switches and single cut-outs may be used. Where the secondary conductors pass out of the transformer house they should do so separately, in earthenware or other fireproof tubes or casings.

RULE 30. When the "multiple parallel" (or "multiple series") system is intended to be used in any building, the insulation of the conductors should be of the highest possible character, similar to that described in Rule 29, for the primary conductors when transformers are used; and all work should be of the very best possible description, and on the surface where practicable. Every parallel (or series) must have an efficient automatic "protector" of such make and design that if the difference of potential of that parallel should rise to 25 per cent. above the normal from any cause whatsoever, then the protector will instantly bring back the potential to the normal, or else cut out the parallel (or series). Means must also be adopted in the dynamo room for maintaining the constancy of the current whatever number of lamps may be burning. A main switch must be placed in a fireproof box in a secure and accessible position outside the buildings when the electricity is generated externally; when the source is internal then it must be situated in the dynamo room (any place wherein the electricity is generated). Efficient precautions must be taken to prevent earthing of the conductors either inside or outside the premises.

RULE 31. When a building is supplied with current upon the three-wire system, the electro-motive force of the current in the building will be considered from a fire point of view equivalent to that existing between the first and last conductors of the series. If the system has more than three wires, the electro-motive force of the current will be considered as depending upon the particular wires of the series brought in, and their relation to the outer ones of the series.

RULE 32. When electricity is supplied from a central station, each conductor therefrom must be provided at their points of entrance into the premises with a switch and cut-out, which should be outside the building or buildings if possible. If these switches and cut-outs cannot satisfactorily be placed outside, they must be fixed inside at the entrance of the conductors into the building, and the conductors must be brought inside in as secure a manner to accessible points, where the switches and cut-outs may be securely placed. The importance is insisted upon of taking all precautions with regard to the prevention of fire when placing in the service lines, and coupling them up to the house wiring. The cut-outs should act at or below 50 per cent. above the normal current, and both the cut-outs and switches should be effectually protected against moisture. When the service lines are brought into buildings containing inflammable goods, or where there is any special risk, the service lines, main cut-outs, and the meter should be all enclosed in a fire-proof chamber, out of which the house mains should pass in approved fire-proof tubes. (This rule is intended to apply to systems not covered by Rule 30.) The occupier should be able to turn off the electricity entirely from his premises whenever he considers it necessary. The switches should be of quick and wide break type.

RULE 33. When high-tension currents are used from a central station (or other place) to charge accumulators, and secondary house circuits having a current of lower potential than that of the primary circuit are taken from the accumulators, then the secondary conductors should be provided with a device or arrangement by means of which their connection with the accumulators during the time these latter were being charged would be prevented. A current having an electro-motive force of 500 volts or upwards will be considered as a high-tension current for this purpose.

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RULE 34. In any electric light installation in which the current is continuous and has an electromotive force of 220 volts or under, the insulation resistance over the whole installation should not be below the following:—

Installations of	25	Lights	500,000 Ohms.
,,	50	,,	250,000 ,,
,,	100	,,	125,000 ,,
,,	500	,,	25,000 ,,
,,	1,000	,,	12,500 ,,

When the lights are proportionate between the above numbers, then the insulation resistance should be correspondingly proportionate. The insulation resistance of the separate circuits of the installation should also be taken, and should be in accordance with the above table.

For alternating currents the minimum insulation resistance must be twice the above number of ohms respectively. Under normal conditions the fall of potential in the conductors in a building should not exceed two volts at the farthest point of any circuit when all the lamps are alight.

An isolated installation should contain an automatic device that would give a warning if a leak were set up to earth in any portion of the premises.

RULE 35. Wherever electricity is supplied from a central station, accurate insulation tests should be made at least once daily over the whole system. This is especially essential where transformers are employed, or when the multiple parallel (or multiple series) system is used.

RULE 36. All conductors from a central station entering, or connected to, or traversing any building or buildings, should have an arrangement of lightning dischargers. Overhead conductors, supported by poles on roofs, will be considered as being connected to those buildings on which the poles are situated. In private installations where the electricity is generated at a distance, the carrying mains should have lightning dischargers.

RULE 37. Special precautions may be required to be taken with regard to electrical work in the case of warehouses and hazardous risks.

RULE 38. In very hazardous risks, special precautions may have to be taken, such precautions necessarily varying according to the peculiarity of the circumstances of the hazard. For instance, with regard to theatres, the work should be of a special character—the work in connection with batten, wing and float lights should be incombustible if possible, the switch board incombustible, and arranged with the view of the minimum amount of danger arising if a fire broke out about it; the work in connection with floor plugs, or temporary attachments, should be special, great care being taken to prevent any liability of heating being set up in them from bad contacts or other causes; fixed conductors on the stage should be in oak, or other specially approved casings; any loose conductors should have very strong coverings to their insulation; all lights must be at a safe distance from all inflammable materials; and all work specially protected against liability to injury. In paper mills, the greatest precautions must be taken against damp and corrosive vapours or gases. Very special precautions have to be taken in sugar mills, and in certain saw mills, and in some places it may not be advisable to put up electrical work. Where naphtha or certain chemicals are used, a solvent action may be set up on the insulation, or the chemicals employed may act upon the electrical work and slowly or quickly eat it away; the conditions may, in fact, be such that it would not be advisable to place up electrical work.

RULE 39. The same general safeguards must be taken for electrical heating and cooking as for lighting. Conductors employed for supplying current for electrical cooking or heating should never be attached to a lamp socket, but to proper terminals of a circuit, the conductors of which have a large carrying capacity, each conductor must have a switch and cut-out.

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RULE 40. All work to be accurately tested at the time of erection for insulation and conductivity, and all installations should be periodically examined and tested.

RULE 41. Before the electrical installation is used, notice should be sent to the insuring office, in order that an opportunity may be given for the installation to be inspected with regard to its fire risk. Full particulars of the proposed installation and all its details should be supplied. The particulars must include a statement of the maximum current to be sent down the various conductors, and the electromotive force of the current; also whether the current is to be direct or alternating, and whether generated on the premises or supplied from a central station. Samples of the conductors must be sent, that they may be examined. Specimens of the cut-outs, protectors, switches, and ceiling roses may be required should the description of them be obscure or unsatisfactory. It is advisable that these particulars be sent before the work of installation is commenced.

The Phœnix "Rules" also contain a set of what are termed "Useful Facts" for the guidance of electrical contractors and their clients.

The following are the Rules and Regulations for the Prevention of Fire Risks arising from Electric Lighting issued by the INSTITUTION OF ELECTRICAL ENGINEERS of London. They are revised and remodelled from the Rules issued by the Society of Telegraph Engineers in 1883, and from other sources of information, both home and foreign, and recommended by the Council in accordance with the Report of the Committee appointed by them to consider the subject.

These general rules are not intended to supersede any detailed rules which fire offices may issue for their own protection, and it is desirable that before the electric light is used, notice should be sent to the fire office in which the building is insured, in order that an opportunity may be given for inspecting the installation. The chief difficulties which beset the electrical engineer are internal and invisible, and they can only be effectually guarded against by testing with special apparatus and electric currents; they arise from leakage and from bad connections and joints, which lead to waste of energy and the production of heat to a dangerous extent. The necessity cannot be too strongly urged for guarding against the presence of moisture, which leads to loss of current and to the destruction of the conductors and apparatus by corrosion and otherwise. Injudicious connections of any part of the circuit with the "earth" tend to magnify every other source of difficulty and danger. Many of the dangers in the application of electricity arise from ignorance and inexperience on the part of those who supply and fit up inadequate plant, and frequently from injudicious economy on the part of the user. The greatest element of safety is, therefore, the employment of skilled and experienced electrical engineers to specify the method in which the work is to be done and the quality of the materials to be employed, and to supervise the execution of the work.

RULE 1. Conductors must have a sectional area and conductivity so proportioned to the work they have to do that, if double the current proposed is sent through them, the temperature of such conductors shall not exceed 150° F.

2. The conductors, or their casings, should be placed in sight if possible; and they should always be as accessible as circumstances will permit.

3. Within buildings they should all be insulated; and this rule applies equally to all conductors and parts of fittings which may have to be handled.

4. Whatever insulating material is employed, it should not soften until a temperature of 170° F. has been reached, and in all cases the material must be damp-proof.

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5. When leads pass through roofs, floors, walls, or partitions, and where they cross or are liable to touch metallic substances, such as bell wires, iron girders, or pipes, they should be thoroughly protected by suitable additional covering; and where they are liable to abrasion from any cause, or to the depredations of rats or mice, they should be encased in some suitable hard material.

6. In the case of portable fittings with which flexible leads are used special precautions must be taken.

7. Conductors should be kept as far apart as circumstances will permit, the spacing between them being governed by their potential difference.

8. When conductors are carried in very inflammable structures, precautions should be taken to isolate them therefrom.

9. Conductors which are protected on the outside by lead, or metallic armour of any kind, require the greatest care in fixing, on account of the large conducting surface which would become connected to the core in the event of metallic contact between them.

10. In cases where conductors pass into a building, from one building to another, or from one room to another, precautions should be taken to prevent the possibility of fire or water passing along the course of the conductors.

11. All joints must be mechanically and electrically perfect, to prevent heat being generated at these points. When soldering fluids are used in making joints, the latter should be carefully washed and dried before insulation is applied.

12. Under all circumstances complete metallic circuits must be employed. Gas and water pipes must never form part of the circuit, as their joints are rarely electrically good, and therefore become a source of danger.

13. Overhead conductors, whether passing over or attached to buildings, must be insulated at their points of support. Precautions must be taken to obviate all risk of short-circuiting where they are likely to touch a building or other overhead conductors and wires, either by their own falling, or by being fallen upon by other conductors.

14. In the case of overhead wires, every main should have a lightning protector at each point where it enters or branches into a building.

15. Metal fastenings for fixing conductors should be avoided; but, when unavoidable, some additional covering should protect the conductor from mechanical injury at such fixing points.

16. The insulation of a system of distribution should be such that the greatest leakage from any conductor to earth (and, in case of parallel working, from one conductor to the other, when all branches are switched on, but the lamps, motors, &c., removed), does not exceed one five-thousandth part of the total current intended for the supply of the said lamps, motors, &c., the test being made at the usual working electromotive force.

17. It will often be found a great convenience and assistance in the prevention of accidents if the positive lead be coloured differently to the negative, or made otherwise distinguishable.

18. Every switch or commutator should be of such construction as to comply with the following condition, namely:—That when the handle is moved or turned to and from the positions of "on" and "off," it is impossible for it to remain in any intermediate position, or to permit of a permanent arc, or heating.

19. The handles of every switch must be completely insulated from the circuit.

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20. The main switches of a building should be placed as near as possible to the point of entrance of the conductors, or to the generators of the current if they are within the building itself. Switches should be provided on both leads.

21. Switch-boards should bear clear instructions for their use by the inexperienced.

22. Switches, commutators, resistances, bare connections, lamps, &c., must be mounted on incombustible bases. Cut-outs mounted on bases of wood rendered uninflammable are admissible. Vulcanite bases are undesirable in damp situations. The cracking of porcelain and earthenware fittings is a source of danger which can be avoided by precautions in fixing.

23. All circuits should be protected with cut-outs; and all leads from the mains, or small conductors from larger ones, must be fitted with cut-outs at their branching points.

24. Where fusible cut-outs are used, the section should be so situated within its frame that the fused metal cannot fall where it may cause a "short-circuit" or an ignition.

25. For all main conductors a cut-out should be provided for both the "flow" and "return," and the two fusible sections must not be in the same compartment.

26. The flexible leads of portable fittings must in all cases be protected by cut-outs at their fixed points of connection.

27. Arc lamps must always be guarded by lanterns or netted globes, so as to prevent danger from ascending sparks and from falling glass and incandescent pieces of carbon.

28. All parts of the lamps and lanterns which are liable to be handled (except by the persons employed to trim them) should be insulated.

29. The armatures and field-magnet coils should be thoroughly insulated. Dynamos should always be fixed in dry places, and they must not be exposed to dust flyings or other industrial waste products carried in suspension in the air. They should not be permitted in the working-rooms of mills, where the liability to such dangers exists, or where any inflammable manufactures are carried on or inflammable materials are stored.

30. Motors should be subject to the same conditions; but when it is necessary to use them in positions such as those above referred to, they must be securely cased in, such cases having a non-combustible lining.

31. Both primary and secondary batteries should be placed and used under the same precautions as prescribed for dynamos; and the room in which they are placed should be well ventilated. The batteries themselves must be well insulated.

32. When these are used to transform either direct or alternating currents of high electromotive force—that is, from or to an electromotive force of, say, 200 volts—they, together with their switches and cut-outs, must be placed in a fire and moisture proof structure—preferably outside the building for which they are required. No part of such apparatus should be accessible except to the person in charge of their maintenance.

33. In all cases conductors conveying currents of high electromotive force inside buildings must be specially and exceptionally insulated, cased in, and the casing made fireproof.

34. The positive and negative terminals connected to such conductors should not be permitted to be nearer each other than twelve inches.

35. Transformers which, under normal conditions of load, heat above 150° F., should not be permitted to remain in use.

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36. Transformers should be so constructed that under no circumstances whatever should a contact between the primary and secondary coils lead the high E.M.F. into the building.

37. The value of frequently testing and inspecting the apparatus and circuits cannot be too strongly urged as a precaution against fire. Records should be kept of all tests, so that any gradual deterioration of the system may be detected.

38. Cleanliness of all parts of the apparatus and fittings is essential to good maintenance.

39. No repairs or alterations must be made when the current is "on."

All the above rules, for the reduction to a minimum of the risks from fire, are also applicable in principle to installations of electricity for other uses than that of lighting; they also include precautions necessary to avoid risk of injury to persons, whether the conductors and apparatus are situated inside or outside a building.

With regard to the Fire Risk Rules which regulate the policies of other British Fire Offices, owing largely to the efforts made by Mr. M. H. Pryor, the managing director of the Sun Office, with the assistance of Mr. Human, of the Guardian, and others, the following sets of Rules have been agreed upon by about 25 of the leading offices. Slight modifications in the "Conditions" are noticeable in some of the Rules of which we have received copies, and the Table of Conductors varies slightly. The Tables (A) and (B) given herewith are those issued by the Guardian Office; (A) is based upon Mr. A. E. Kennelly's Tables of Limiting Current, and the fuse wires from Mr. Preece's Table, the latter of which will be found on a subsequent page of this DIRECTORY AND HANDBOOK, as will also a more detailed Fuse Table and Diagram compiled by Mr. Clarence Feldmann. The chief modification in the Rules now agreed upon, and those previously issued, is in the increase in the standard of conductivity and insulation, and in the more general recognition of concentric wiring, under certain restrictions.

Among the leading Companies by whom these Rules are issued may be mentioned the Guardian, Sun, North British and Mercantile, Liverpool and London and Globe, Alliance, London Assurance Corporation, Hand-in-Hand, Westminster, Royal Exchange, &c., &c.; and risks are undertaken by these Companies under the Rules without extra premium.

The following introduces the Rules:—

The Principal Sources of Danger are:

1. Inferior materials and workmanship, particularly in joints, fittings and connections.
2. Conductors of inadequate size and conductivity.
3. Perishable and inferior insulating material.
4. Dust, dirt and moisture.
5. Undue heating.
6. Neglect of frequent testing and inspection.

No installation can be accepted in which all these are not adequately provided against. The employment of competent engineers, to prepare specifications for, and to superintend, and of responsible firms to carry out all installations is most strongly to be urged.

Notice of the introduction or extension of electric lighting plant must in all cases be given to the Fire Office, and any alteration in the details should likewise be notified.

The following rules are generally applicable. If deviations should be found necessary in special cases, they must be subject to the approval of the Fire Office.

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RULES.

I. SOURCES OF ELECTRICITY.—(A) No machinery for generating electricity must be placed in any room in which inflammable material is manipulated, or in which easily inflammable material is stored, or which has openings into any room in which inflammable material is manipulated, or in which any processes causing dust or flyings are carried on.

(B) Dynamos must not be placed within 12 inches of any unprotected combustible material other than their seating; they must be insulated as far as possible, and must be fixed in a dry place, free from dust and as cool as practicable.

(C) Dynamos must be marked with their maximum capacity in volts and amperes, and also with their maximum safe speed, which must under no circumstances be exceeded. Voltmeters, ammeters and speed indicators should be fitted, and if the apparatus is not completely self-regulating a competent person must be constantly in attendance.

II.—Primary and secondary batteries must be set in a dry place free from dust, and well ventilated. They must be insulated. Incandescent lamps only must be used in battery rooms.

III. CONDUCTORS.—(A) Conductors (except in the case of the concentric system of wiring) must be of copper, of a conductivity not less than 98 per cent. of that of pure copper.

(B) Conductors must be so proportioned to the amount of current to be carried by them, that in no case shall the temperature of the conductor exceed 18°F. or 10°C. above the surrounding air. (*See* Table A.)

(C) Conductors must at no point be exposed to a temperature exceeding 140°F.

NOTE.—Subject to special sanction, bare conductors may be used in the concentric system, and also in lofty buildings in positions only accessible to authorised persons, if carried upon suitable insulators and exposed to view.

TABLE A.

The insulation of a system of distribution shall be such that the leakage to earth (and from conductor to conductor in parallel working) shall not exceed *one twenty-thousandth* part of the total current at full working load.

Conductors.		Current in Amperes.	Amperes per square inch.	No. of 64-Watt Lamps.	Fuse Wires, S.W.G.			Insulation Resistance of System. (E.M.F. = 100 V.)	
S.W.G.	Diam. Ins.				Lead.	Tin.	Copper.	Amperes.	Ohms.
20	·036	3·9	3,800	6	24	26	40	1	2,000,000
18	·048	5·9	3,250	9	22	24	36	5	400,000
16	·064	9·0	2,800	12	20	21	32	10	200,000
14	·080	12·6	2,500	18	18	19	30	20	100,000
7/22	·084	13·6	2,450	20	18	19	30	30	66,600
7/20	·108	19·8	2,150	30	16	17	28	40	50,000
7/18	·144	30·5	1,870	45	14	15	24	50	40,000
7/16	·192	47·9	1,620	75	11	12	22	60	33,200
7/14	·240	65·8	1,450	100	9	10	20	70	28,572
7/12	·312	97·8	1,275	150	7	8	18	80	25,000
19/22	·140	29·5	1,900	40	14	15	24	90	22,200
19/20	·180	42·7	1,675	65	12	13	22	100	20,000
19/18	·240	65·8	1,450	100	9	10	20	120	16,664
19/16	·320	101·0	1,250	155	7	8	18	150	13,320
19/14	·400	142·0	1,130	218	5	6	16	200	10,000
19/12	·520	210·0	980	320	2	3	14	300	6,640

TABLE B.

Table of Edison-Swan Lamps, on a basis of 1,000 amperes per square inch section of copper conductor, giving fair working results when not exceeding 100 amperes of current.

Lamps up to 25 c.p. are computed at 4 watts per candle. Lamps above that power at 3·5 watts per candle.

S.W.G.	100-Volt Lamps.					
	8 c.p.	16 c.p.	25 c.p.	50 c.p.	100 c.p.	200 c.p.
20	3	1	...	...	...	...
18	5	2	1	1	...	...
16	10	5	3	2	1	...
14	16	8	5	3	2	1
7/22	12	6	4	2	1	...
7/20	20	10	6	4	2	1
7/18	40	20	13	8	4	2
7/16	68	34	23	13	6	3
7/14	116	58	37	22	10	5
7/12	200	100	65	37	18	9
19/22	34	17	11	6	3	1
19/20	56	28	18	10	5	2
19/18	110	55	35	20	10	5
19/16	190	95	63	36	18	9
19/14	316	158	103	59	30	14
Amperes per Lamp.	·32	·64	1·0	1·75	3·5	7·0

Fuse Wires and Insulation resistances as in Table A.

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RULE 16. House mains and all the principal branches when the current is supplied from a central station or from accumulators to have switches on both poles. The arrangement should be such that the current can be entirely cut off from the lights in any portion of the building the occupier may desire. All the principal portions of a building, therefore, should be controlled by double switches. All switches to be of such construction and make that they will not be liable after short use to get out of order and heat or fire. Their construction should also be such that it would be impossible for them to remain in any intermediate position between full-on and off. All switches must be mounted and placed in such a secure manner that no danger can arise in the event of their heating. They must also be so mounted that leakage of electricity from them is rendered impossible. Switches inside buildings must always have an incombustible base, the insulation of which should be perfect. No metal work carrying current should be exposed at the underside of the base. The cover should be incombustible, and they should be kept perfectly free from moisture. Switches contained in lamp sockets will only be allowed where permission to use them has been obtained. Where practicable every room and every passage should be controlled by a separate switch. The current carried by the last controlling switch should not exceed 6 amperes.

RULE 17. A switch and a cut-out on each conductor should be placed outside a building at or near the entrance of the conductors, when the electricity is generated externally. When switches and cut-outs cannot satisfactorily be placed outside a building, they must be fixed inside at the entrance of the conductors into the building, in accessible positions. When the building is in the occupancy of various tenants, each tenant must have a double switch and double cut-outs at the points of entrance of the conductors into his tenancy (preferably on the outside). When the source of supply is internal, a switch and a cut-out should be placed on each conductor in the dynamo-room.

RULE 18. Switch-boards should be composed of a non-conducting fireproof material, and they should be in a dry and secure place, and be most carefully fixed and mounted, and the arrangement of the conductors at the back should, if possible, be such, that if on fire, the fire could not spread to the rest of the installation. It is preferable for switch-boards to be "split," *i.e.*, the positive portion separated from the negative part. All switch-boards should have an oak, teak, or mahogany frame with glass front.

RULE 19. Resistances, bare or other connections, lamps, &c., must be so mounted that no danger could arise in the event of their heating, and that leakage of electricity from them is impossible. Resistances must be mounted on an incombustible material, and kept well away from inflammable materials.

RULE 20. Inflammable materials must be kept at a perfectly safe distance from incandescent lamps, which sometimes get exceedingly hot.

RULE 21. No naked lights allowed. If arc lights are used, they must be furnished with globes, which must be enclosed at the base, and so arranged at the top that no sparks or flame can escape. The globes must be covered round with wire netting. When arc lights are run in series, means must be taken for maintaining the constancy of the current, whatever number of lamps may be burning.

RULE 22. All lamp-holders must be incombustible, and of an approved type. The ends of flexible wire, when composed of fine strands, should be soldered before being attached to holders. All ceiling roses should be composed of an incombustible material, and be most carefully made and fixed. They should be fastened to back blocks. Wall sockets must also be composed of an incombustible material, and the greatest care exercised in fixing them.

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RULE 23. Electroliers should be fastened to an insulating block, which should be separately fixed to the wall or ceiling. Each electrolier should be protected by cut-outs.

RULE 24. Gas fittings and electric light work should be kept quite distinct from each other. Gas fittings must never be utilised for the electric light, unless specially made for the purpose, and are so arranged that it would be impossible for them to be the means of an "earth" being set up.

RULE 25. Concentric conductors may be used under certain circumstances, but all joints and connections must be so made that freedom from undue heating is absolutely secured; and the outer conductor must be so securely protected that all danger from injury, corrosion or other causes (electrical or otherwise) is effectually prevented, while precautions must be taken to prevent the conductors being affected by moisture.

The insulation resistance between the internal wire and the return of a concentric conductor before being placed up should not be less than 250 megohms per mile; the electromotive force of the current not exceeding 210 volts. The internal wire should be positive, if possible. The insulation must be impervious to moisture, of approved thickness, and have two approved metallic envelopes (the first one forming the return conductor, the second one forming the "guard"); these, except when the system is earthed, must be insulated from each other in such a manner that the internal wire and the return are insulated from each other. The "guard" must be an absolutely efficient protection against mechanical injury taking place to the return conductor, and be also an efficient protection against any accession of moisture to the insulation, especially when the sytem is earthed. The carrying capacity of the conductors must be at least equal to the ratio of that laid down for copper in Rule No. 2; if, however, a metal other than copper be used, the specific resistance of which is greater than that of copper, then the sectional areas of the conductors must be proportionally increased. All switches and cut-outs must be enclosed in approved fireproof boxes. No earth connection will be allowed to a gas pipe, or to lead or compo pipes. If any part of a concentric system be earthed, then the whole system must be concentric: unless permission to the contrary be given. Switches and cut-outs should always act on the internal (or live) wire when the system is earthed. The insulation resistance of the work when placed up must never be below that given in Rule No. 34 for general wiring. When the system is earthed the tests, of course, will refer to the pole that is unearthed.

RULE 26. No dynamo, motor, or any apparatus for generating electricity is to be placed in any working room of any cotton, woollen, flax, jute, or corn mill; or in any mill or factory of a like description; or in any working room or place where any hazardous process is carried on, or in which any hazardous goods are stored, or where there is special risk. The engine-room or mechanics' shop not considered as a "working room." Transformers and accumulators will come under this rule. Wherever a dynamo (or other apparatus for generating electricity) is placed, especial care should be taken to see that the dynamo be thoroughly well insulated from earth. The same rule must be observed with regard to motors and accumulators.

RULE 27. Where accumulators or primary batteries are used, the mains, both positive and negative, must have a switch and a cut-out upon each. The principal branches must also be protected in a similar manner. Accumulators must be kept where there is good ventilation. The conductors from the regulating cells of the accumulators to the regulating switch-board must be protected by cut-outs as close to the regulating cells as possible. It should be possible to turn off the current at the accumulators whenever required. The lug connections of accumulators should be periodically examined.

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IV.—(A) Conductors (except as below) must be protected throughout with durable coverings affording

1. Adequate electrical insulation.
2. Adequate protection from injury.
3. Permanent and complete exclusion of moisture.

(B) Such coverings must consist respectively of—

1. India-rubber, or other approved insulating material or materials of sufficient thickness, not softening so as to allow of its being displaced at a temperature below 160° F., nor easily inflammable.
2. Braiding or tape.
3. Coatings of varnish, or other suitable waterproofing composition.

(C) The resistance of the insulation of conductors at 60° F. must in no case be less than 300 megohms per statute mile.

(D) Metal sheathing may be used to provide special protection from moisture, or from injury by vermin or abrasion, but the greatest care is required to avoid contact between the actual conductor and the sheathing, also between the sheathing and any other conducting body.

(E) In all installations where the concentric or other approved special system of wiring is adopted, the work must be carried out, not only subject to these regulations as far as applicable, but also in accordance with such authorised rules as may be issued in respect of such system.

V.—Twin wires, and wires with an inner coating of india-rubber, covered with silk or cotton, should only be used for flexible leads to movable and pendant lamps.

VI.—(A) All conductors must be cased throughout, except as before-mentioned; where permitted without such casing their attachments must be such as to prevent sagging.

(B) Casings must have a continuous central rib separating the conductors, which rib must exceed in width the diameter of the grooves carrying the conductors, and in no case be less than $\frac{3}{8}$ inch. Care must be taken that this rib is not injured by screws and nails, which must on no account penetrate into the grooves.

(C) "Bunching" of conductors can only be allowed where no material difference of potential exists between contiguous wires.

VII.—Conductors or their casings should be in sight, and must be as accessible as circumstances admit.

VIII.—(A) Conductors passing through party or division walls must be placed in separate tubes or channels of stoneware, or other incombustible material, set in cement. Care must be taken to prevent the possibility of fire or water passing through the apertures, and of injury to the insulation by the cement or other substances used. Conductors carried through partitions, through or under floors or roofs, and wherever they are concealed from view, must, if not cased, be kept at least six inches apart, and so arranged as to minimise the risk of injury.

(B) Conductors exposed to injury from vapour, water, vermin, or other causes, as in battery rooms, must be provided with suitable additional protection beyond that specified in Rule IV. Stoneware tubes or channels are the safest protection, but care must be taken to prevent the entry of moisture. Bare conductors are in some cases the safest.

(C) The possibility of water running along conductors, or between any conductor and any other conductor or conducting body whatever, must be effectually guarded against. Where conductors pass near other conductors and metallic or other bodies capable of conducting electricity, such as pipes, every precaution must be taken to prevent contact therewith.

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IX.—Metal staples must not be used for fixing conductors.

X.—No gas or water pipes must form part of a circuit, and no direct earth connection can be permitted, except in concentric wiring.

XI.—(A) Neither the leakage of electricity to earth from the whole of any installation, nor the leakage from the supply conductor to the return conductor when all branches are switched on but the lamps, motors, &c., removed, must exceed $\frac{1}{20000}$ part of the total working current, even when tests are made under the most unfavourable conditions of dampness. Under dry conditions double this insulation resistance must be insisted on.

(B) All tests must be made at the E.M.F. intended to be used, but in no case less than 100 volts.

XII.—(A) All joints must be carefully made, spliced and soldered, and insulated; the insulation of the joint being made equal to that of the cable. Resin should be used as a flux, but if soldering fluids are used the joint must be thoroughly washed and dried before the insulating material is applied.

(B) Conductors should be constructed with as few joints as possible, and all connections with fittings and appliances must be securely made and have full electrical contact.

The Board of Trade Rule No. 26 provides that "Overhead conductors shall not in any part thereof be within 7 feet of any building or erection other than a support for the conductor, except where brought into a building for the purpose of supply."

XIII. ARC LIGHTS.—(A) Arc lamps must be properly guarded by lanterns netted globes, or other means. They must be so constructed as to prevent the escape of hot carbon and sparks.

(B) Arc lamps in parallel with their choking or resistance coils (*see* Rule XVIII.) must each be protected by a fusible cut-out.

XIV. FITTINGS.—(A) All fittings for incandescent lamps, except in the case of concentric wiring, must be insulated as far as practicable at their bases, and the conductors protected from injury by abrasion. No part of any mounting must be used to carry current.

(B) Gas fittings must in no case be used to carry electric lights without special sanction. Such sanction will only be given subject to the wiring being carried out with extra precautions, especially where the supply of electricity is derived from a source of high E.M.F.

XV. SWITCHES.—(A) Switches must have incombustible mountings. They must have rubbing surfaces of ample size; must work from "on" to "off" with a sharp break, and be incapable of producing a permanent arc.

(B) Switch handles, and all fittings intended to be handled, must be properly insulated.

(C) Switch-boards must bear clear instructions as to their use.

XVI.—Controlling switches must be placed in both main conductors, in an accessible position, as near the source of supply as possible.

XVII. CUT-OUTS.—(A) Cut-outs must be placed in positions where they are exposed to view and easily accessible, and not under floors or behind skirtings, and precautions must be taken to prevent their being tampered with or made inoperative.

(B) Cut-outs must have incombustible mountings, and be so constructed that the fused metal cannot cause a short circuit. Covers should be fitted.

(C) Cut-outs must be placed in both main leads, between the source of the supply and the controlling switch.

(D) Cut-outs must be placed on every branch where it is led off from a main conductor, and on every sub-station of a branch conductor intended to carry

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8 amperes, or upwards. They must be as close to the junction as practicable, and must be so made as to act before any wire in the circuits controlled is heated 18° F. above the surrounding air. In general, cut-outs should be arranged to break circuit when an excess of 50 per cent. over the usual working current has been reached.

(E) Flexible leads and pendant fittings must be provided with cut-outs at their fixed points of connection.

(F) Fusible cut-outs must have the distance between their terminals proportionate to the E.M.F. in no case less than 1 inch.

(G) Where the system employed does not allow of fusible cut-outs, effective automatic safety cut-outs must be substituted.

NOTE.—In the case of arc lights in series, cut-outs may be dispensed with, provided that the dimensions and insulation of the conductors be adequate, the regulating mechanism of the lamps efficient, and proper precautions taken in other respects.

XVIII. RESISTANCE COILS.—Resistance coils must be securely fixed on incombustible mountings, and not placed within 12 inches of any combustible material unless such material is sufficiently protected.

XIX. MOTORS.—Where electro-motors are employed, the same care must be taken as with dynamos, and all their connections must be arranged in conformity with these Rules. When used where inflammable material is manipulated or stored, they must be furnished with incombustible cases, and danger from sparking carefully guarded against.

XX. TRANSFORMERS.—Both alternating and battery transformers should be placed outside the building; but if this is impracticable, then as near the point of entry of the primary conductors as possible, and they must be so fitted that damage cannot occur in the event of a leakage of the high-tension primary current into the secondary circuit. The whole of the high-pressure conductors and apparatus connected therewith must be completely enclosed in solid walls or in strong fire-proof metal casing, efficiently connected to earth, and accessible to none but authorised persons.

XXI. ALTERNATING CURRENTS.—Switches and cut-outs must be fitted to operate on both terminals of all circuits used with alternating currents. None but the best materials and workmanship throughout will be allowed where alternating currents are in use.

The Royal Insurance Company issue no printed regulations, the Company's Surveyor reporting upon each case; and the London and Lancashire is amongst those Companies which adopt the Phœnix Rules.

AMERICAN ELECTRIC LIGHTING FIRE RISK RULES.

The following is an *abstract* of the Rules and Requirements of the Underwriters' International Electric Association of the United States for the installation of wiring and apparatus for electric light and power. It may be mentioned that early in 1894 it is proposed to hold a Conference in America, at which will be discussed a set of Electric Fire Risk Rules having universal application throughout the United States:—

CENTRAL STATIONS.

[These Rules also apply to Dynamo Rooms in Isolated Plants, connected with or detached from buildings used for other purposes; also to all varieties of apparatus therein of both high and low potential.]

Generators must be located in a dry place; must be insulated on floors or base frames which must be kept filled, to prevent absorption of moisture, and also kept clean and dry; must never be placed in a room where any hazardous process is

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carried on, nor in places where they would be exposed to inflammable gases, or flyings, or combustible material; and must each be provided with a waterproof covering.

From generators, switch boards, rheostats, or other instruments, and thence to outside lines, conductors must be in plain sight and readily accessible; must be wholly on non-combustible insulators, such as glass or porcelain; must be separated from contact with floors, partitions or walls, through which they may pass, by non-combustible insulating tubes, such as glass or porcelain; must be kept rigidly so far apart that they cannot come in contact; must be covered with non-inflammable insulating material sufficient to prevent accidental contact, except that "bus bars" may be made of bare metal and must have ample carrying capacity, to prevent heating.

Switchboards must be so placed as to reduce to a minimum the danger of communicating fire to adjacent combustible material; must be accessible from all sides when the connections are on the back; or may be placed against a brick or stone wall when the wiring is entirely on the face; must be kept free from moisture; must be made of non-combustible material, or of hard wood in skeleton form, filled to prevent absorption of moisture; bus bars must be equipped in accordance with the Rule for placing conductors.

Resistance Boxes and Equalizers must be equipped with metal, or other non-combustible frames; must be placed on the switchboard, or, if not thereon, at a distance of a foot from combustible material, or separated therefrom by a non-inflammable, non-absorptive, insulating material.

Lightning arresters must be attached to each side of every overhead circuit connected with the station; must be mounted on non-combustible bases in plain sight on the switchboard, or in an equally accessible place, away from combustible material; must be connected with at least two "earths" by separate wires, not smaller than No. 6 B. & S., which must not be connected to any pipe within the building; must be so constructed as not to maintain an arc after the discharge has passed.

Testing.—All series and alternating circuits must be tested every two hours while in operation, to discover any leakage to earth, abnormal in view of the potential and method of operation; all multiple arc low potential systems (300 volts or less) must be provided with an indicating or detecting device, readily attachable, to afford easy means of testing where the station operates continuously; data obtained from all tests must be preserved for examination.

Motors must be wired under the same precautions as with a current of the same volume and potential for lighting. The motor and resistance-box must be protected by a double pole cut-out and controlled by a double pole switch; must be thoroughly insulated, mounted on filled dry wood, be raised at least eight inches above the surrounding floor, be provided with pans to prevent oil from soaking into the floor and must be kept clean; they must be covered with a waterproof cover when not in use, and, if deemed necessary, be enclosed in an approved case.

Resistance Boxes must be equipped with metal or other non-combustible frames, and must be placed on the switchboard, or at a distance of a foot from combustible material, or separated therefrom by a non-inflammable, non-absorptive, insulating material.

ARC (SERIES) SYSTEMS (OVER 300 VOLTS).

All outside, overhead conductors (including services) must be covered with some approved insulating material,* not easily abraded, firmly secured to properly

* Insulation that will be approved for service wires must be solid, at least $\frac{3}{64}$ of an inch in thickness, and covered with a substantial braid. It must not readily carry fire, must show an insulating resistance of one megohm per mile after two weeks submersion in water at 70 degrees Fahrenheit, and three days submersion in lime water, with a current of 550 volts and after three minutes electrification.

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insulated and substantially built supports, all tie wires having an insulation equal to that of the conductors they confine. Outside conductors must be so placed that moisture cannot form a cross-connection between them, not less than a foot apart, and not in contact with any substance other than their insulating supports; they must be at least seven feet above the highest point of flat roofs, and at least one foot above the ridge of pitched roofs over which they pass or to which they are attached; they must be protected by *dead, insulated guard-irons* or *wires* from possibility of contact with other conducting wires or substances to which current may leak. Special precautions of this kind must be taken where sharp angles occur or where any wires might possibly come in contact with electric light or power wires. Outside conductors must be provided with petticoat insulators of glass or porcelain. Porcelain knobs or cleats and rubber hooks will not be approved. Outside conductors must be so spliced or joined as to be both mechanically and electrically secure without solder. The joints must then be soldered, to insure preservation, and covered with an insulation equal to that on the conductors..

Service blocks must be covered over their entire surface with at least two coats of waterproof paint. Telegraph, telephone, and similar wires must not be placed on the same cross-arm with electric light or power wires.

All interior conductors must be covered where they enter buildings from outside terminal insulators to and through the walls, with extra waterproof insulation, and must have drip loops outside The hole through which the conductor passes must be bushed with waterproof and non-combustible insulating tube or hard rubber tube, slanting upward toward the inside. The tube must be sealed with tape, thoroughly painted, and securing the tube to the wire. Interior conductors must be arranged to enter and leave the building through a double contact service switch, which will effectually close the main circuit and disconnect the interior wires when it is turned "off." The switch must be so constructed than it shall be automatic in its action, not stopping between points when started, and prevent an arc between the points under all circumstances; it must indicate ot inspection whether the current be "on" or "off," and be mounted in a non-combustible case, and be kept free from moisture, and easy of access to police or firemen. Interior conductors must be always in plain sight, and never encased, except when required; and must be covered in all cases with an approved non-combustible material that will adhere to the wire, not fray by friction, and bear a temperature of 150 degrees F. without softening; they must be supported on glass or porcelain insulators, and kept rigidly at least eight inches from each other, except within the structure of lamps or on hanger-boards, cut-out boxes, or the like, where less distance is necessary; they must be separated from contact with walls, floors, timbers, or partitions through which they may pass by non-combustible insulating tube or hard rubber tube; and they must be so spliced or joined as to be both mechanically and electrically secure without solder. They must then be soldered, to insure preservation, and covered with an insulation equal to that on the conductors.

Arc lamps, in every case, must be carefully isolated from inflammable material; must be provided at all times with a glass globe surrounding the arc, securely fastened upon a closed base (no broken or cracked globes to be used); must be provided with an approved hand-switch, also an automatic switch, that will shunt the current around the carbons should they fail to feed properly; must be provided with reliable stops to prevent carbons from falling out in case the clamps become loose; must be carefully insulated from the circuit in all their exposed parts; must be provided with a wire netting around the globe, and an approved spark arrester above to prevent escape of sparks, melted copper, or carbon, where readily inflammable material is in the vicinity of the lamps. It is recommended that plain carbons, not copper-plated, be used for lamps in such places. Hanger-boards must be so constructed that all wires and current-carrying devices thereon shall be exposed to view, and thoroughly insulated by being mounted on a waterproof,

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non-combustible substance. All switches attached to the same must be so constructed that they shall be automatic in their action, not stopping between points when started, and preventing an arc between points under all circumstances.

Incandescent lamps in series circuits having a maximum potential of 300 volts or over must be governed by the same rules as for arc lights, and each series lamp provided with an approved hand-spring switch and automatic cut-out, and must have each lamp suspended from a hanger-board by means of a rigid tube. No electro-magnetic device for switches and no system of multiple-series or series-multiple lighting will be approved. Under no circumstances can series lamps be attached to gas fixtures.

INCANDESCENT (LOW PRESSURE) SYSTEMS (300 VOLTS OR LESS).

OUTSIDE CONDUCTORS.

Outside overhead conductors must be erected in accordance with the rules for arc (series) circuit conductors, and must be separated not less than 12 inches, and be provided with an approved fusible cut-out, that will cut off the entire current as near as possible to the entrance to the building and inside the walls.

Underground conductors must be protected against moisture and mechanical injury, and be removed at least two feet from combustible material when brought into a building, but not connected with the interior conductors. They must have a switch and a cut-out for each wire between the underground conductors and the interior wiring when the two parts of the wiring are connected. These switches and fuses must be placed as near as possible to the end of the underground conduit, and connected therewith by specially insulated conductors, kept apart not less than two and a half inches. Underground conductors must not be so arranged as to shunt the current through a building around any catch-box.

INSIDE WIRING.

At the entrance of every building there shall be an approved switch placed in the service conductors by which the current may be entirely cut off.

Conductors must have an approved insulating covering, and must not be of sizes smaller than No. 14 B. & S., No. 16 B. W. G., or No. 4 E. S., G., except that in conduit installed under Rule 22, No. 16 B. & S., No. 18 B. W. G., or No. 4 E. S. G., may be used.

They must be protected when passing through floors, or through walls, partitions, timbers, &c., in places liable to be exposed to dampness, by waterproof, non-combustible, insulating tubes, such as glass or porcelain, and they must be protected when passing through walls, partitions, timbers, &c., in places not liable to be exposed to dampness, by approved insulating bushings specially made for the purpose. They must be kept free from contact with gas, water, or other metallic piping, or any other conductors or conducting material which they may cross (except high potential conductors) by some continuous and firmly fixed non-conductor creating a separation of at least one inch. Deviations from this rule may sometimes be allowed by special permission.

Conductors must be so placed in crossing high potential conductors that there shall be a space of at least one foot at all points between the high and low tension conductors, and must be so placed in wet places that an air space will be left between conductors and pipes in crossing, and the former must be run in such a way that they cannot come in contact with the pipe accidentally. Wires should be run *over* all pipes upon which condensed moisture is likely to gather, or which by leaking might cause trouble on a circuit.

Wiring not encased in moulding or approved conduit must be supported wholly on non-combustible insulators, constructed so as to prevent the insulating coverings of the wire from coming in contact with other substances than the insulating supports; must be so arranged that wires of opposite polarity, with a

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difference of potential of 150 volts or less, will be kept apart at least two and one-half inches; must have the above distance increased proportionately where a higher voltage is used, unless they are encased in moulding or approved conduit; must not be laid in plaster, cement, or similar finish, and must never be fastened with staples.

Wires in unfinished lofts, between floor and ceilings, in partitions, and other concealed places, must have at least one inch clear air-space surrounding them, and must be at least ten inches apart when possible, and should be run singly on separate timbers or studding. Wires run as above immediately under roofs, in proximity to water-tanks or pipes, will be considered as exposed to moisture. Wires must not be fished for any great distance, and only in places where the above rules have been complied with. Twin wires must never be employed in this class of concealed work.

Mouldings must never be used in concealed work or in damp places; must have at least two coats of waterproof paint or be impregnated with a moisture repellant, and must be made of two pieces, a backing and capping, so constructed as to thoroughly encase the wire, and maintain a distance of one-half inch between conductors of opposite polarity, and afford suitable protection from abrasion.

In buildings specially liable to moisture or acid, or other fumes liable to injure the wires or insulation, except where used for pendants, conductors must be separated at least six inches; must be provided with an approved waterproof covering, and must be supported by glass or porcelain insulators. No switches or fusible cut-outs will be allowed where exposed to inflammable gases or dust, or to flyings of combustible material. Conductors must be protected when passing through floors, walls, partitions, timbers, &c., by waterproof, non-combustible, insulating tubes, such as glass or porcelain.

Interior conduits must be continuous from one junction-box to another, or to fixtures, and must be of material that will resist the fusion of the wire or wires they contain, without igniting the conduit. They must not be of such material or construction that the insulation of the conductor will ultimately be injured or destroyed by the elements of the composition. They must be first installed as a complete conduit system, without conductors, strings, or anything for the purpose of drawing in the conductors, and the conductors then to be pushed or fished in. They must not be supplied with a twin conductor, or two separate conductors, in a single tube. Conduits *must have all ends closed* with good adhesive material, either at junction boxes or elsewhere, whether such ends are concealed or exposed. Joints must be made air-tight and moisture-proof. Conduits must extend at least one inch beyond the finished surface of walls or ceilings until the mortar or other similar material be entirely dry, when the projection may be reduced to half an inch.

Double pole safety cut-outs must be in plain sight or enclosed in an approved box, readily accessible, and must be placed at every point where a change is made in the size of the wire (unless the cut-out in the larger wire will protect the smaller). They must be supported on bases of non-combustible, insulating, moisture-proof material, and must be supplied with a plug (or other device for enclosing the fusible strip or wire) made of non-combustible and moisture-proof material, and, and so constructed that an arc cannot be maintained across its terminals by the fusing of the metal. Cut-outs must be so placed that on any combination fixture no group of lamps requiring a current of six amperes or more shall be ultimately dependent upon one cut-out. All cut-out blocks must be stamped with their *maximum* safe-carrying capacity in amperes, and *when installed* must be marked with the current they are intended to carry.

Safety fuses must all be stamped or otherwise marked with the number of amperes they will carry indefinitely without melting. They must have fusible wires or strips (where the plug or equivalent device is not used), with contact surfaces or tips of harder metal, soldered or otherwise, having perfect electrical

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connection with the fusible part of the strip, and must all be so proportioned to the conductors they are intended to protect that they will melt before the maximum safe-carrying capacity of the wire is exceeded.

Switches must be mounted on moisture-proof and non-combustible bases, such as slate or porcelain. They must be double-pole when the circuits which they control supply more than six 16-candle power lamps, or their equivalent. They must have a firm and secure contact; must make and break readily, and not stop when motion has once been imparted by the handle, and must have carrying capacity sufficient to prevent heating. Switches must be placed in dry, accessible places, and be grouped, as far as possible, being mounted—when practicable—upon slate, or equally non-combustible backboards. Jackknife switches, whether provided with friction or spring-stops, must be so placed that gravity will tend to open rather than close the switch.

In all cases where conductors are concealed within or attached to gas-fixtures, the latter must be insulated from the gas-pipe system of the building by means of approved joints. The insulating material used in such joints must be of a substance not affected by gas, and that will not shrink or crack by variation in temperature. Insulating joints with soft rubber in their construction will not be approved. All conductors for fixture work must have a waterproof insulation that is durable and not easily abraded, and must not in any case be smaller than No. 18 B. & S., No. 20 B. W. G., No. 2 E. S. G. Each fixture must be tested for "contacts" between conductors and fixtures, for "short circuits," and for ground connections before the fixture is connected to its supply conductors. Ceiling blocks of fixtures should be made of insulating material; if not, the wires in passing through the plate must be surrounded with hard rubber tubing.

Arc lights on low potential circuits must be supplied by branch conductors not smaller than No. 12 B. and S. gauge; must be connected with main conductors only through double pole cut-outs, and must only be furnished with such resistances or regulators as are enclosed in non-combustible material, such resistances being treated as stoves. Incandescent lamps must not be used for resistance devices. Arc lights on low circuits must be supplied with globes and protected, as in the case of arc lights on high potential circuits.

SOCKETS.—No portion of the lamp-socket exposed to contact with outside objects must be allowed to come into contact with either of the conductors. In rooms where inflammable gases may exist, or where the atmosphere is damp, the incandescent lamp and socket should be enclosed in a vapour-tight globe.

Flexible cord must be made of conductors, each surrounded by a moisture-proof and a non-inflammable layer, and further insulated from each other by a mechanical separator of carbonisable material. Each of these conductors must be composed of several strands. The cord must not sustain more than one light not exceeding 50-candle power, and must not be used except for pendants, wiring of fixtures, and portable lamps or motors. The cord must be equipped with keyless sockets as far as practicable, and be controlled by wall-switches.

ALTERNATING SYSTEMS.—CONVERTERS OR TRANSFORMERS.

Converters must not be placed inside of any building, except the Central Station unless by special permission. They must not be placed in any but metallic or other non-combustible cases, and must not be attached to the outside walls of buildings, unless separated therefrom by substantial insulating support.

In cases where it may not be possible to exclnde the converters and primary wires entirely from the bullding, the following precautions must be strictly observed:—Converters must be located at a point as near as possible to that at which the primary wires enter the building, and must be placed in a room or vault constructed of, or lined with, fire-resisting material, and used only for the purpose. They must be effectually insulated from the ground, and the room in which they are placed be practically air-tight. Primary conductors must each be heavily

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insulated with a coating of moisture-proof material from the point of entrance to the transformer, and, in addition must be covered and protected that mechanical jury to them, or contact with them, shall be practlcally impossible. They must each be furnished, if within a building with a switch and a fusible cut-out where the wires enter the building, or where they leave the main line, on the pole or in the conduit. These switches should be enclosed in secure and fire-proof boxes, preferably outside the building. Primary wires must be kept apart at least ten inches, and at the same distance from all other conducting bodies when inside a building. Secondary conductors must be installed according to the rules for "Low Potential Systems.

ELECTRIC RAILWAYS.

All rules pertaining to arc-light wires and stations shall apply (so far as possible) to street-railway power stations and their conductors in connection with them.

Power stations must be equipped in each circuit as it leaves the station with an *approved* automatic "breaker," or other device that will immediately cut off the current in case the trolley wires become grounded. This device must be mounted on a fire-proof base, and in full view and reach of the attendant.

Trolley Wires must be no smaller than No. 0, B. & S. copper or No. 4, B. & S. silicon bronze, and must readily stand the strain put upon them when in use. They must be well insulated from their supports, and in case of the side or double-pole construction, the supports shall also be insulated from the poles immediately outside of the trolley wire. They must be capable of being disconnected at the power-house, or of being divided into sections so that, in case of fire on the railway route, the current may be shut off from the particular section, and not interfere with the work of the firemen. This rule also applies to *feeders*. Trolley wires must be safely protected against contact with all other conductors.

Lighting and power from railway wires must not be permitted, under any pretence, in the same circuit with trolley wires with a ground return, nor shall the same dynamo be used for both purposes, except in street-railway cars, electric-car houses, and their power stations.

STORAGE OR PRIMARY BATTERIES.

When current for light and power is taken from primary or secondary batteries, the same general regulations must be observed as apply to similar apparatus fed from dynamo generators developing the same difference of potential. All secondary batteries must be mounted on *approved* insulators.

MISCELLANEOUS.

The wiring in any building must test free from grounds : *i.e.*, each main supply line and every branch circuit shall have an insulation resistance of at least 25,000 ohms, and should have an insulation resistance between conductors and between all conductors and the ground (not including attachments, sockets, receptacles, &c.) of not less than the following :—

Up to	10	amperes	4,000,000	Up to	200	amperes	160,000
,,	25	,,	1,600,000	,,	400	,,	80,000
,,	50	,,	800,000	,,	800	,,	22,000
,,	100	,	300,000	,,	1,600	,,	11,000

Where telephone, telegraph, or other wires connected with outside circuits are bunched together within any building, or, where inside wires are laid in conduit or duct with electric light or power wires, the covering of such wires must be fire-resisting, or else the wires must be enclosed in an air-tight tube or duct.

All conductors connecting with telephone, district messenger, burglar alarm, watch clock, electric time and other similar instruments, must be provided near the

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point of entrance to the building with some protective device which will operate to shunt the instruments in case of a dangerous rise of potential, and will open the circuit and arrest an abnormal current flow. Any conductor normally forming an innocuous circuit may become a source of fire hazard if crossed with another conductor, through which it may become charged with a relatively high pressure.

The following formula for soldering fluid is suggested :—Saturated solution of zinc, 5 parts; alcohol, 4 parts; glycerine, 1 part.

FRENCH ELECTRIC LIGHT INSTALLATION RULES.

The rules published in 1892 by the Chambre Syndicale des Industries Électriques is one of the latest additions to the numerous rules which have been issued for the guidance of contractors. There are several useless regulations and one or two very vaguely worded ones. British and American Rules are given elsewhere, and we publish these regulations rather to show what is being done on the Continent than as an example to be followed :—

I.—QUALITY OF MATERIAL.

1. All wires and cables to be of copper, having a conductivity of at least 90 per cent. of that of pure copper. [That is to say, having a specific resistance of 1,800.—ED. *Elec. Dir.*]

2. Their section must be determined by the condition that the fall of volts between the service box and the most distant lamp is not to exceed 3 per cent. of the voltage at the service box. They are, moreover, to be of such a size that the accidental passage of double the normal current shall not warm them up more than 40°C. This result will in general be obtained if the current density does not exceed

3	amperes	per	sq. mm.	for	wires of 1 to 5	sq. mm.
2	„	„	„	„	5 to 20	„
1	„	„	„	„	over 50	„

Finally, no conductor is to be employed of which the core consists of a single wire having a diameter less than 0·9mm. [To convert amperes per square millimetre into amperes per square inch, multiply by 645. Wire of 0·9mm. diameter is approximately No. 20 B.W.G.]

3. The use of bare wires, forbidden as a rule, may be allowed in special cases. Whatever the nature of the location may be, either the insulating coating of the wire or the mechanical protecting sheath must be impervious.

4. Insulation must be obtained by one or more layers of non-conducting materials placed directly upon the copper core. This covering must be sufficiently strong to stand handling when being installed.

5. *Mechanical Protection.*—As a general rule wires are always to be provided with mechanical protection independent of their insulating covering. If conductors are laid along walls in damp places, the mechanical protection must be impervious. Wood casing may be used in dry places. The casing must be of dry wood, and provided with covers. When wires are allowed to remain open to view in dry places, which must as much as possible only be the case when they are beyond reach, they must be protected by ribbon, braiding, or some other covering independent of the insulating material.

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6. *Switches.*—The material composing the bases of switches must be appropriate to the nature of the locality. Switches must make good contact, and must not heat when the current is passing. When the breaking of the circuit may give rise to an appreciable arc, for instance, 5 amperes at 100 volts, the apparatus must not remain in an intermediate position, and its base must be of incombustible and unbreakable material.

7. *Cut-Outs and Fuses.*—Cut-outs must be arranged so that the fusing of a plug will not give rise to a short circuit. Fuses must be easy to replace, and not give rise to any spluttering of molten metal. They must be clearly marked with a number representing the normal current for which they are intended. They should fuse for a current equal at the most to three times the normal.

8. *Arc Lamps.*—Arc lamps are always to be provided with a covering and a cinder holder. Lamps exposed to the weather are to have their terminals well protected from the rain and from blows. Rheostats are to be mounted on incombustible non-hygroscopic bases. Wires are to be such as not to exceed a temperature of 200°C. under normal conditions of working.

II.—CONDITIONS FOR LAYING DOWN INSTALLATIONS.

9. *Conductors.*—Casings which serve as a mechanical protection to the conductors should not exhibit any discontinuity at joints or sharp angles. Conductors are only to be kept in them by means of the cover. Two wires are not to be laid in the same groove. When crossing gas pipes there must be additional insulation and mechanical protection. When passing through walls and ceilings, the mechanical protection should preferably take the shape of a hard tube with rounded angles. If this tube is metallic a supplementary insulating sheath should surround the wire and project beyond the ends of the tube. When separate conductors are visible they must be at least 1 centimetre apart, and fixed, so as to keep this distance.

10. *Double Wires.*—Double conductors having within one and the same braiding or covering two separately insulated wires may be used; but the electrical insulation of the two cores, and their distance apart, must be thoroughly well assured. This rule is equally applicable to conductors of the same polarity.

11. *Flexible Wires.*—Flexible wires are only to be used when they are inevitable. They are to be joined up to the apparatus in such a manner that the insulation of the wires cannot be torn off. They are to be connected up to thick wires by means of carefully-soldered joints. A fuse wire is to be placed at one of the points of connection between a flexible wire and the two main conductors.

12. *Soldered Joints.*—Soldered joints are to be done without the use of corrosive liquid substances. They should not form weak points, either mechanically or electrically, and the electrical insulation must be restored with insulating materials equivalent to those which form the covering of the cables or wires.

13. *Switchboards and Auxiliary Apparatus.*—It is always desirable that circuits should branch off from switchboards, sub-divided as far as possible. These switchboards are to be kept well away from the walls, and the wires and cables are as far as possible to be joined up on the front. Necessary precautions must be taken to avoid short circuits due to contact with some metallic object.

14. *Cut-Outs.*—Each circuit is to be provided at its starting point with a double-pole cut-out. Each branch circuit is to be similarly fitted, and also each sub-branch carrying 5 amperes. The cut-outs must be easy of access and shielded from inflammable materials.

15. *Apparatus.*—If any piece of apparatus carries a large number of lamps, the lamps are to be divided into several groups, none of which must consume more than 5 amperes, and each group is to be provided with a double-pole cut-out. Lustres,

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brackets, &c., used exclusively for electricity, are to be electrically insulated at their point of support, and the body of the apparatus is not to form part of the circuit. Their sockets are to be fixed so as not to turn. When these apparatus are used both for gas and electricity they must fulfil the following conditions :—

(i.) The frame of the apparatus must be electrically insulated from the gas mains by at least 500,000 ohms.

(ii.) Incandescent lamp sockets and the framework of arc lamps must be electrically insulated from the frame of the apparatus.

(iii.) Finally the wires, well insulated and protected, are to be fixed so as to follow the shape of the apparatus, and so as not to be injured by the heat of the gas.

16. *Arc Lamps.*—Each arc light circuit is to include a switch and a fuse wire. If resistances are used they must be fixed in such a manner as to avoid contact with any inflammable material, and sufficiently removed from the wall to prevent it being injured by the heating of the wire. They must also be arranged so that circulation of the air is assured.

17. *Insulation.*—The insulation must be such that in any section of the installation the current leakage between a conductor and earth or between the two conductors shall not exceed one ten-thousandth of the current which is supplied to the apparatus connected to that section. For instance, a branch circuit traversed by 10 amperes should have an insulation such that the leakage current does not exceed 0·001 ampere, and in this particular case with 100 volts on the circuit its insulation will be at least 100,000 ohms.

LLOYD'S SUGGESTIONS FOR THE USE OF ELECTRIC LIGHT ON BOARD VESSELS.

The Committee of Lloyd's issue the following suggestions relating to the use of the electric light on board vessels, for the consideration of Shipowners and others :—

I.—*Position of Dynamos and of Electric Motors.*—Dynamos and electric motors should be placed as far as possible from all compasses, and should be at least 30ft. from the standard compass.

II.—*Cables.*—In vessels fitted with continuous-current dynamos, and wired on the single-wire system, no single cable should be carried within 15ft. of any compass, and cables conveying a heavy current should be fixed at still greater distance. If it is necessary to fix the cables within this distance, then for all parts of the vessel lighted from this cable the double-wire system should be adopted, the return wire being carried as near the flow as possible in the vicinity of the compasses.

III.—*Adjustment of Compasses.*—The compasses should be adjusted with the dynamo not working, after which the vessel's head should be put upon the different courses, with the dynamo running at full speed, and on each course the indications of the compass should be noted with the dynamo running with open circuit and with all possible combinations of the current switched "on" and "off" all circuits passing near the compasses. These indications should be compared with those obtained with the dynamo stopped, and any serious deflections of the compasses remedied before the vessel sails. In vessels wired on the "double-wire" system this is not so important as in those wired on the "single-wire" system, but at least the effect should be tested of the dynamo running with open circuit.

IV.—*Leads or Circuits.*—1. The copper used in all leads should have a conductivity of at least 98 per cent. that of pure copper, and the sectional area should be at least in the proportion of one square inch per 1,000 amperes carried.

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2. No single wire of less than 16 standard wire gauge should be used. For portable leads stranded cables composed of smaller wires may be used.

3. The insulation resistance of all wires should be not less than 600 meghoms per statute mile, after 24 hours' immersion in sea water.

4. If india-rubber insulation is used, the wires should be first covered with a layer of pure rubber, then with a separator, then with a layer of vulcanising india-rubber, and then with a layer of india-rubber coated tape. The whole should then be vulcanised together. The cable should afterwards be satisfactorily protected, preferably with a braided covering of tarred fibre.

5. Wires which are insulated with any other material than india-rubber should fulfil the same conditions as to insulation resistance, and should be of equal durability with those above specified.

6. The leads should be placed where they can always be accessible; if they are laid in wood battens the covers should be screwed on, not nailed, and care should be taken that the casings are impervious to moisture. If the leads are not encased they should be secured by screwed clips, not staples, but unprotected leads should only be used where it is impossible to enclose them. Cables which are properly covered with protective metal sheathing may, however, be unencased.

7. All cables which are liable to be exposed to moisture, more especially when they are also exposed to heat, should be lead-covered, or be otherwise specially protected. This refers to such places as open alleyways, near galleys, oil lamps, boiler casings, engine room, &c.

8. All cables led through cargo spaces, coal bunkers, *or spaces which may at any time be used for carrying cargo or baggage, or which are not at all times accessible*, should be lead-covered and further protected by wrought-iron casings, or be led through metal tubes.

9. Where cables pass through beams, or bulkheads, they should be led through special fittings of hard wood to prevent their being chafed, and where they pass through decks they should be led through metal tubes lined with wood, or fibre, and securely fastened to the decks, standing at least 6in. above the deck level.

10. In vessels having spaces allotted alternately for passengers and cargo, the lamp fittings in these spaces should be portable, and the terminals so arranged that they can be properly covered up with insulating covers. The switches and cut out should be outside these spaces, and should be fitted so that they are under lock and key.

V.—*Joints in Leads.*—1. Joints in main leads should be avoided if possible. If joints cannot be avoided in the main leads they should, after the wire is carefully jointed, soldered and insulated, be encased in a satisfactory watertight junction box. If the cables are lead-covered, perfectly sound lead soldered junctions should be made over the joints.

2. Joints in branches, or of branches with main leads, should have the copper wires thoroughly soldered; the insulation should be carefully carried out, and all the joints should be made watertight. Joints in flow and return wires should not be made opposite one another.

3. For soldering wires resin only should be used as a flux.

VI.—*Joints with Hull.*—In vessels fitted on the single-wire system, all the joints with the hull should be in accessible positions. They should be made with brass screws not less than three-eighths of an inch in diameter, carefully tapped into the bteel, having white brass washers, between the wires and steel, or the wires should se soldered to brass-faced washers.

VII.—*Switches and Cut-outs.*—1. A main switchboard should be fitted in the dynamo room, to which all the main circuits throughout the ship should be brought,

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a switch and cut-out being fitted for each circuit. If auxiliary switchboards for further sub-division of the current are necessary, they should be placed in conveniently accessible positions, and each small circuit should be fitted with a separate switch and cut-out.

2. In cases where electric lights are used for the mast-head light and side lights, the switches controlling these lights should be placed in a position where they can be controlled by the officer of the watch, or other responsible person, and cannot be tampered with by other members of the crew, or by passengers, &c.

3. The switches should be mounted on slate or other uninflammable bases, and should be so constructed that they must either fall "on" or completely "off," that is, they must not be able to remain in an intermediate position. They should have ample rubbing surfaces, and their conductivity should not be less than that of the wires connected to them.

4. Cut-outs should be fitted to the circuit as near as possible to each of the dynamo terminals, and also to each circuit as near as possible to the switches of the circuits.

5. All cut-outs should be in easily accessible places. They should be mounted on slate or other uninflammable bases and be arranged so that the fused metal may not be a source of danger. They should also have non-inflammable covers.

6. The fuses should be of non-oxidisable metal, and should be so proportioned as to melt with a current 50 per cent. in excess of the normal current, that is, they should melt with a current in the proportion of 1,500 amperes per square inch of section of the wires they protect. The main fuses are preferably to be subdivided into small wires instead of using one large wire.

7. In vessels wired on the double-wire plan cut-outs should be fitted to each wire.

VIII.—*Tests, &c.*—1. On completion of an electric lighting installation on board a vessel, the insulation of all the circuits should be tested before the trial run has been made, and after a trial of six hours' duration with all the lights in circuit, and should fulfil the following conditions:—

2. The insulation resistance over the whole installation should not be below the following:—

Installation of	25	lights	500,000 Ohms.
„	50	„	250,000 „
„	100	„	125,000 „
„	500	„	25,000 „
„	1,000	„	12,500 „

3. When the lights are between the above numbers then the insulation resistance should be correspondingly proportionate.

4. The insulation resistance of the separate circuits of the installation should also be in accordance with the above tables.

5. For alternating currents the minimum insulation resistance should be twice that given in above table.

6. A voltmeter and an ampere-meter should be supplied with each installation.

IX.—*In Vessels carrying Petroleum.*—All switches and cut-outs should be fitted in places not liable to the accumulation of petroleum vapour or gas, and all lamps in places where it is possible for gas to accumulate should be made with an outer glass globe hermetically sealed. All wires in such places should be lead-covered, or the insulation of the cables employed should be of such a nature as not to be affected by petroleum.

By order of the Committee,

A. G. DRYHURST, *Secretary.*

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INSTALLATION REGULATIONS OF THE ELECTRIC SUPPLY COMPANIES OF THE METROPOLIS.

We give below in full the instructions for installation work issued by :—

(1.) The Metropolitan Electric Supply Company (Limited).
(2.) The Kensington and Knightsbridge Electric Lighting Company (Limited).
(3.) The Chelsea Electricity Supply Company (Limited).
(4.) The City of London Electric Lighting Company, (Limited).
(5.) St. Pancras Vestry.

The instructions issued by other Metropolitan Companies are similar, except where in the paragraphs following their dissimilarity is referred to.

THE METROPOLITAN ELECTRIC SUPPLY COMPANY (LIMITED).

CONDUCTORS.—*Copper.*—In every conductor the copper to be tinned and of such sectional area that the current in it shall not exceed 1,000 amperes per square inch, and of such area with respect to its length that the fall of pressure between the point where the Company's wires are connected to the installation and the furthest lamp therein shall not exceed two per cent.

Single conductors must never be encased in zinc or other metal tubes of a greater length than 2ft. Where there is absolute necessity for such mechanical protection, both conductors should be placed together in a tube large enough to prevent any abrasion of the insulation. Lead-covered wires must not be used under any circumstances. No conductors, under any circumstances whatever, to be fixed by means of staples. All wiring work to be executed in accordance with the rules of the Fire Insurance Companies.

SWITCHES AND FUSES.—All switches to be of such design that they cannot possibly remain in any intermediate position between "on" and "off," and should have good endurable rubbing contacts. No metal parts carrying current to be exposed.

FUSES.—It is very desirable that a fuse be placed both in the positive and negative wires at every change of section, and this must be done as far as practical conditions will allow. A double-pole fuse must be placed in the mains at a point of supply, to be decided upon by the Company, and the mains continued to reach the converter or other apparatus of the Company.

GAS-FITTINGS.—No gas fittings are to be wired under any circumstances whatever, unless the same are efficiently insulated from the gas supply pipe.

DISTRIBUTION OF CIRCUITS.—In the case of buildings requiring more than 50 amperes, the Company will be glad to receive particulars of the circuits proposed.

TESTING AND INSPECTION.—No current will be supplied to any installation until the inspector of the Company has tested the insulation resistance and certified that the work is satisfactory.

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The Company retains the right, without previous notice, to at any time cut off the supply to the whole or part of any installation if the insulation is defective, or the installation otherwise unsafe.

No current will, under any circumstances whatever, be turned on to any installation until the whole of the work is entirely finished.

In the event of any additional lights being turned on before they have been tested, and passed by an inspector of the Company, the whole of the installation will be cut off the circuit until such tests have been made.

VOLTAGE.—In all ordinary cases the current will be supplied at a pressure of 50 or 100 volts, but other voltages can be supplied if special satisfactory reasons are given. The Company strongly recommends the use of 50 volts.

ARC LAMPS.—Arc lamps must be provided with suitable inductive choking coils, to be approved by the Engineer of the Company.

TRANSFORMERS, METERS, &c.—Transformers and main switches in the primary will be supplied and fixed by the Company. The Company will send an inspector to decide upon the position of transformer and meter. The Company will fix the meter, and connect it to a bight, which must be left in the main for the purpose.

SPECIAL APPARATUS.—All special apparatus, such as resistance and impedance coils, to be approved by the Engineer of the Company.

THE KENSINGTON AND KNIGHTSBRIDGE ELECTRIC LIGHTING COMPANY (LIMITED).

WIRING.—All the work inside houses is to be carried out in accordance with the rules issued by the Fire Insurance Companies. The insulation resistance of wire used to be not less than—(1) In dry places, 300 megohms per mile; (2) in damp places, 600 megohms per mile; (3) in plaster-work and walls, 1,000 megohms per mile. No joints should be made in wires which are to be buried in casing in walls. All joints in the insulation to be covered with at least six laps of pure rubber; the braiding, cotton, or tape should be cut away on either side of the joint, leaving the insulating material and copper conductor to be covered with the pure rubber; when this has been put on the whole may be covered with protecting tapes, each layer to be soaked in india-rubber solution.

BRANCH CIRCUITS.—No switch should turn on at one time more than twenty 16 candle-power lamps or one high candle-power lamp, or one series of arc lamps taking 10 amperes normal current. Each branch circuit must be provided with means of disconnecting it on both poles. No disused circuit is allowed to be left with the current on the wires, but must be cut off close to the mains, or double pole cut-outs must be introduced between the mains and branch, and the fuse wires left out.

FITTINGS.—In all cases where fittings in connection with gas pipes are used the whole fitting must be insulated in an efficient manner from the gas supply pipe, and all the metal lamp-holders must be insulated by ebonite or other suitable material from the fitting. All combination gas and electric light fittings must be examined by the Company's inspector.

FUSES, &c.—All circuits to be protected by two single-pole cut-outs, and at the entrance to each house two single-pole cut-outs and two single-pole switches to be fixed to the house mains. All fuses to be marked with name-plates, showing what circuits they belong to.

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TESTING.—The Company make one test and inspection free of charge. A fee of 10s. 6d. must be paid at the Company's office before any further tests are made. Notice in writing must be given to the Company, by the contractors, 24 hours before a supply is required to be turned on. The Company will not supply current to any installation (1) if there are any temporary wires or fittings, (2) if the whole of the work is not completed and all fittings fixed, (3) if, when testing with the full pressure of 100 volts, the insulation resistance is below the following standard:—

For 12	Lamps...	...	5	megohms.	For 150	Lamps...	...	0·75	megohms
„ 25	„ ...	...	2·5	„	„ 200	„ ...	...	0·5	„
„ 50	„ ...	...	1·5	„	„ 250	„ ...	...	0·3	„
„ 75	„ ...	...	1·25	„	„ 300	„ ...	...	0·2	„
„ 100	„ ...	...	1·0	„					

Previous to a test being made by the Company's Inspector, all fuses must be put in, and lamps fixed; tests must also be made for continuity and short circuits.

THREE WIRE SYSTEM.—In any installation containing more than 200 lamps, or requiring a large and variable supply of current, or current for motive power, the Company reserve to themselves the right of supplying at a pressure of 200 volts, with sub-divided circuits of 100 volts each. Motors above one horse-power should be wound for 200 volts; arc lamps can be supplied four in series.

MOTORS.—All motors must be mounted so that they are efficiently insulated from earth; the insulation test required will be in accordance with the above rule, and will be taken at the equivalent number of lamps as represented by the energy required by the motor. A regulating resistance must be provided for starting the motor to the satisfaction of the Company's Inspector.

ARC LAMPS.—All arc lamps fixed out of doors must have a porcelain insulator of approved pattern, between the lamp and the brackets or support of the lamp, even in cases where the framework of the lamp is not in connection with the circuit.

STREET LAMPS.—Where incandescent lamps are used in lamp-posts, and metal frame incandescent lamp-holders are used fixed to a pipe inside the lantern, an insulating piece of ebonite or porcelain must be inserted between the lamp-holder and the pipe, to prevent an earth circuit being formed by a faulty lamp or by a strand of the wire used touching the body of the lamp-holder.

SERVICE MAINS.—The Company, in all cases, lay the service mains between their mains and the consumer's premises. The Company will only bring the service lines into the consumer's premises at a point nearest to their service manholes; a cut-out or testing box will be fixed at the end of the service mains. The consumer's house mains must be brought out as far as the Company's cut-out box. The cut-out box and any further work in laying wires on the consumer's premises will be charged for by the Company. House mains from the Company's service cut-out box into the house, passing through damp vaults or out in the open, must have an insulation resistance of 2,000 megohms per mile, and must be laid in waterproof wood casing, or lead or iron pipes. The Company will, if required, furnish estimates for carrying out this work. The Company, on receiving proper notice in writing, will point out the position their cut-out boxes will occupy.

METERS.—The Company supply at a fixed rental all meters to be used on their lighting circuits. The Company reserve the right of fixing upon the position of the meter, and require the consumer's house mains to be brought to the meter. The Company will, if required, settle upon the position of the meter before the installation work is finished, if the householder has made proper application to the Company for a supply.

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LEAKAGE.—In the event of the insulation resistance of an installation falling below 5,000 ohms, after a supply has been turned on, and if the Company's servants are not allowed to find or remedy the fault, the whole of the installation will be cut off until the fault has been put right; any expenses the Company are put to in finding such fault are to be repaid to the Company by the consumer. Any circuit which is found defective by the Company's Inspector will be disconnected from the supply, and a printed notice will be affixed at the junction of this circuit with the supply, forbidding the use of this defective circuit until put in order and passed by the Company's Inspector.

INCREASE OF LIGHTING.—In the event of an increase in the lighting of an installation after a supply has commenced, necessitating alterations or additions to the wiring, notice in writing to the Company must be given, and all such work will be tested by the Company when finished, prior to turning on the increased supply. Failure of such notice is liable to enforce the Company to cut off the whole installation (*vide* LEAKAGE).

THE CHELSEA ELECTRICITY SUPPLY COMPANY (LIMITED).

Rules to be observed by contractors wiring houses to be supplied with current from the Company's mains:—

WIRING.—All the work inside houses is to be carried out in accordance with the rules of the Fire Insurance Companies. All conductors to be of such sectional area that the current shall not exceed 1,000 amperes per square inch. When all the lights are in use, the fall of pressure between the Company's main cut-out and any lamp must not exceed 1 volt. No smaller wire than No. 18 S.W.G. to be used or its equivalent in flexible leads. Each branch circuit to be provided with a cut-out on each pole. The maximum number of lamps allowable in any branch circuit must be such that, in the event of a short circuit in the smallest wire forming part of that circuit, the branch fuse must go before the current reaches a density of 2,000 amperes per square inch in that wire, unless each separate lamp is controlled by a double pole cut-out.

MAIN SWITCH.—A double pole switch or two single pole switches must be fixed by the contractor on the house mains *on the consumer's side of the meter*. These switches must be securely fixed and covered over. In the case of a double pole switch the cover must be made of a non-conducting material.

CUT-OUT BOX AND METER.—The Company will fix a main cut-out box, into which they will bring the ends of their service mains. The house-mains must be continued as far as the cut-out box, and the connection to this box will be made by the Company. A bight of cable of from 5 to 6ft. long should be left by the contractor for the connection to the meter. This connection will be made by the Company. The Company's representative will, at the contractor's request, point out the position of the meter and the main cut-out, provided that application has been previously made by the householder for a supply of current.

APPLICATION FOR SUPPLY OF CURRENT.—Forms of application for supply of current are issued. These must be signed by the householder. They must state particulars as to the number and candle-power of lamps proposed to be installed, and approximately the number likely to be in use at one time under ordinary conditions, and the date on which the supply of current is required. This date should allow the Company about 10 days' notice for carrying out the work. If signed by a lady, she should state whether widow or spinster. The Company do not issue any blank forms of application to contractors, but if they will state the name and address of their client, a form will be sent for the same.

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TESTING AND CONNECTION TO MAINS.—No installation will be supplied with current until it has been tested and passed by the Company. The Company will make *one test free of charge*. If it is found that the installation is not ready for testing, or if it fail to pass the test, a fee of 10s. 6d. must be paid at the Company's office before any other test or inspection can be made. The Company will not carry out any test until they have received a written communication from the contractors stating that the installation is quite complete, and making an appointment for the hour of the test. At least 24 hours' notice must be given to the Company before a test can be made, and the contractors must send their representative at the fixed time to give any information concerning the installation that may be required. If the installation should pass the test, it can usually be connected to the mains without further delay should the householder desire it. Contractors who supply and fix fittings to installations already wired are advised to test the insulation of the wires before they commence their work, so as to avoid any misunderstanding with their clients should the Company refuse to connect on the house if the insulation resistance be found not to come up to their requirements. Previous to a test being made by the Company, every fuse in the installation must be inserted, and *all lamps fixed in their holders.*

The Company will not supply current to any installation—

(1) If the work is not carried out in accordance with the rules already stated.

(2) If the whole of the work is not completed and all fittings permanently fixed.

(3) If, when testing with a pressure of 100 volts, the insulation resistance is below the following standard :—

For 10 Lamps	...	8·4	megohms.	For 100 Lamps	...	1·0	megohms.
„ 20 „	...	4·6	„	„ 150 „	...	0·6	„
„ 30 „	...	3·1	„	„ 200 „	...	0·5	„
„ 40 „	...	2·4	„	„ 250 „	...	0·4	„
„ 50 „	...	1·9	„	„ 500 „	...	0·2	„
„ 75 „	...	1·3	„	„ 1000 „	...	0·1	„

PRESSURE.—The current will be supplied at the pressure of 100 volts at the Company's main cut-out.

LEAKAGE.—The Company retains the right to at any time cut off the supply to the whole or part of any installation if the insulation becomes defective, or the installation otherwise unsafe.

ADDITIONAL LIGHTS.—In the event of alterations to the wiring or additional lamps being fixed, notice in writing must be given to the Company, and all such work must be tested by the Company when finished prior to the current being turned on to the altered or new circuits. In the event of this rule not being observed, the whole of the installation will be cut off until the tests have been made.

CITY OF LONDON ELECTRIC LIGHTING COMPANY (LIMITED).

Provided that the length of the line is not greater than 60 feet, the Company will, at its own expense, lay the necessary service from the main to the building of any owner or occupier entitled to be supplied with energy up to a point in a position suitable for the consumers' terminals. The main cut-out, which will contain the consumers' terminals, will be supplied by the Company, will be placed in position by them, and will remain in their sole charge. If a consumer requires a maximum of less than 50 amperes, the main cut-out will have two terminals. If the maximum required is greater than 50 amperes the cut-out will have three terminals, the

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pressure between each outer terminal and the centre one being the same as in the case of two terminals. A main double or treble pole switch of an approved type will be supplied and fixed by the consumer as near to the Company's terminals as possible.

On the application of the consumer, on a form to be obtained from the Secretary of the Company, current will be supplied at a pressure of 100 or 200 volts, unless, in reply to the application for current, notice to the contrary is given by the Company.

The Company will supply a suitable meter; the rates for the rent of the same can be learned on application at the Secretary's office. The Company reserve the right to fix upon a position for the meter as well as for the main cut-out referred to in the first paragraph. Application in this matter should be made to the Engineer as soon as the householder has requisitioned the Company for a supply, and generally before the wiring is commenced.

The whole of the work and material employed in the installation must be of the highest class, and in accordance with the rules of the Fire Insurance Company in whose office the building is insured.

Except in the case of special systems of wiring, referred to below, conductors will be of copper of a conductivity not less than 98 per cent. of Matthiessen's standard of pure copper, and of such sectional area that the current in them shall not exceed 1,000 amperes per square inch. Their area will be so proportioned to their length that the fall of pressure between the supply Company's terminals and the furthest lamp shall not, at times of full load, exceed two volts. It is advisable that all conductors larger in sectional area than No. 14 S.W.G. should be stranded. No conductor of a less total area than No. 18 S.W.G. will be used, except in the case of flexible cords, which may be equal in section to No. 20 S.W.G. All copper must be tinned if the insulation is vulcanised.

Conductors will be highly insulated with vulcanised india-rubber or other equally good and approved material, which will be mechanically protected by means of tapes or braid. Flexible cords will have a waterproof insulation. Generally, the insulation resistance will not be less than 600 megohms per mile, or 1,000 megohms per mile when used in damp places. Lead-covered conductors are not to be used under any circumstances.

All conductors will be placed in hard wood casing, except special systems of conductors, which will be subject to approval by the Engineer of the Company. Where wood casing is used in damp situations, it will be coated both inside and out with varnish, or other waterproof composition. The covers of all casings will be screwed and not nailed down. In special circumstances metal tubes may be used as a protection, but in all such cases both conductors will be placed together in the same tube, which must be of sufficient size to obviate any chance of damage to the conductors when drawing them in or out.

No conductors under any circumstances will be fixed by means of metal staples, but in special cases metal saddles may be used with due precaution.

Fittings and electroliers will, where practicable, be insulated at the base. Flexible cord must not be used for wiring fittings, unless specially insulated. The wiring of gas fittings is expressly prohibited, unless the same are efficiently and satisfactorily insulated from the gas supply pipe.

All the electrical fittings will be of fireproof construction and have incombustible bases. Switches will have substantial rubbing contacts, they will be of such design that they cannot possibly remain in any intermediate position between "on" and "off"; and they will have a positive action in the event of the failure of the spring. No metal carrying current will be exposed.

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Fuses will be placed wherever the section of conductor is lessened. The use of too many fuses should be obviated by running conductors of undiminished area from section distribution boxes to lamps. All fuses should be easily accessible. A single pole fuse in all cases will be fixed at the origin of a flexible cord. All fuses to be of some approved type. Magnetic cut-outs must not in any case be used unless approved of by the Company's Engineer.

In the event of there being more than one tenant in a building, each consumer will provide a double or treble pole main cut-out fixed between the main switch and the Company's terminals.

In cases where arc lamps are intended to be used, the Engineer of the Company will first be consulted in the matter, and the type of lamp, choking coil, &c., must in all cases be subject to his approval.

Installations, when tested by the Company at the full working pressure, will not have a lower insulation resistance than at the rate of 75 megohms per lamp, with all fittings and apparatus connected, and any installation failing to comply with the above will not be supplied with current by the Company.

Should the insulation resistance prove defective when tested by the Company's inspector, a fee of 10s. 6d. must be paid before the second and all subsequent tests by the Company. In all cases in which it is proposed to run mains common to the various tenants in a building, it is requested that the Company's engineer be communicated with before the work is commenced, in order that the Company's requirements may be explained and fully carried out.

In the event of alterations or additions being required to an installation already being supplied with current by the Company, previous notice in writing must be given to the Engineer, with particulars of the work to be undertaken. A breach of this clause may render it necessary for the Company to cut off the supply without notice.

THE VESTRY OF SAINT PANCRAS.

The following directions to contractors on behalf of consumers are issued by the Electricity Committee of the Vestry of St. Pancras :—

INSTALLATIONS OF LIGHT AND POWER.—The Vestry do not undertake any responsibility for the efficiency and proper execution of any wiring work on a consumer's premises. The inspection and installation test is made for the purposes of the Vestry only. The conductors to be of copper tinned, not less than 98 per cent. conductivity, and to be of a sectional area, that the current supply does not exceed 1,000 amperes per square inch, or such other rates as may be required, depending upon the distance to be traversed. No conductors to be less in sectional area than 18 B.W.G. (except in wiring fittings, when 20 B.W.G. may be used), and no solid wire above 16 B.W.G., the larger sizes to be stranded. The insulation resistance of wires in bulk should not be less than 300 megohms per mile, and of an electrical and mechanical quality and covering to be approved. No cotton covered or bare wires will be allowed.

The installation shall be tested by the Vestry's officials, when completed, and the insulation of the whole shall not be less than the following :—

25 Lights	... ...	800,000 ohms.	125 Lights ... ... 160,000 ohms.
50 „	... ...	400,000 „	150 „ ... ... 140,000 „
75 „	... ...	280,000 „	200 „ ... ... 100,000 „
100 „	... ...	200,000 „	

If the installation should be found afterwards to have fallen below 5,000 ohms, the Vestry may discontinue the supply till it has been remedied.

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CASINGS AND COVERS.—These should be of sound, dry, hard wood, of sectional dimensions to be approved, the grooves and inner faces should have two coats of varnish or insulating and waterproof paint. If wires are not enclosed in casing they must be fixed on insulators, and not less than 6 inches apart. No installation will be connected to the supply mains that has got wires hung about in a temporary or loose manner. Wires under floors are not desirable. Staples should not be used.

SWITCHES.—To be on an insulated base of slate or porcelain, they should have quick "off" breaks and ample contacts. No conductor must be exposed. Switches forming a part of fittings should be well insulated.

CUT-OUTS, CEILING ROSES, AND WALL CONNECTORS.—Cut-outs should be of porcelain, suitably fixed to the casing, and have porcelain or glass covers. The size of fuse to be marked proportionate to the number of lamps it is required to protect. All branches from mains to be protected by double pole fuses. Where a flexible pendant is required, it should be suspended from a porcelain or slate based ceiling rose, the cover also being incombustible. Provided with a fuse or cut-out, and the wires well separated. If wall connectors are used they should have porcelain or slate base, the connections being of approved make and fitted with fusible cut-out.

Joints should be carefully made, soldered (resin only being used), and well insulated.

Where existing gas-fittings are proposed to be utilised for carrying lights, the wires, &c., should be carried by suitable insulated clips. No metal work of any fitting shall be used as a metallic circuit, and no "earth" connections are allowed.

ARC LAMPS.—The suspenders for these must be insulated from the body of the lamp, and the leads should also be insulated and secured to prevent chafing and abrasion. Resistances for arc lamps to be fixed on insulated frames, and enclosed, with means of ventilation. Suitable switches and cut-outs must be provided.

MOTORS.—The insulation resistance of the field magnet and armature winding of a motor shall be subject to the same regulations as laid down for lighting. A suitable starting switch, with resistances, mounted on insulated frames, and an approved cut-out, must be provided.

ACCUMULATORS.—Where these are used, the fixing and arrangement, together with charging switches and fuses, must be first submitted for the approval of the electrical engineer to the Vestry.

No addition shall be made to any installation that has been tested by the Vestry's officials, until due notice has been given on the form provided. Failing, this, the supply is liable to be stopped till all is in order.

Similar rules to the above are issued by all the Electricity Supply Companies, only slight differences occurring. We have selected the above rules as being representative, and to serve as a guide to those using or contemplating the use of a high or low pressure supply. In all the rules of which we have been successful in obtaining copies it is explicitly laid down that all interior work must be in accordance with the rules issued by the Fire Insurance Companies. With regard to rules issued by provincial companies, these are, for all practical purposes, similar to those given above.

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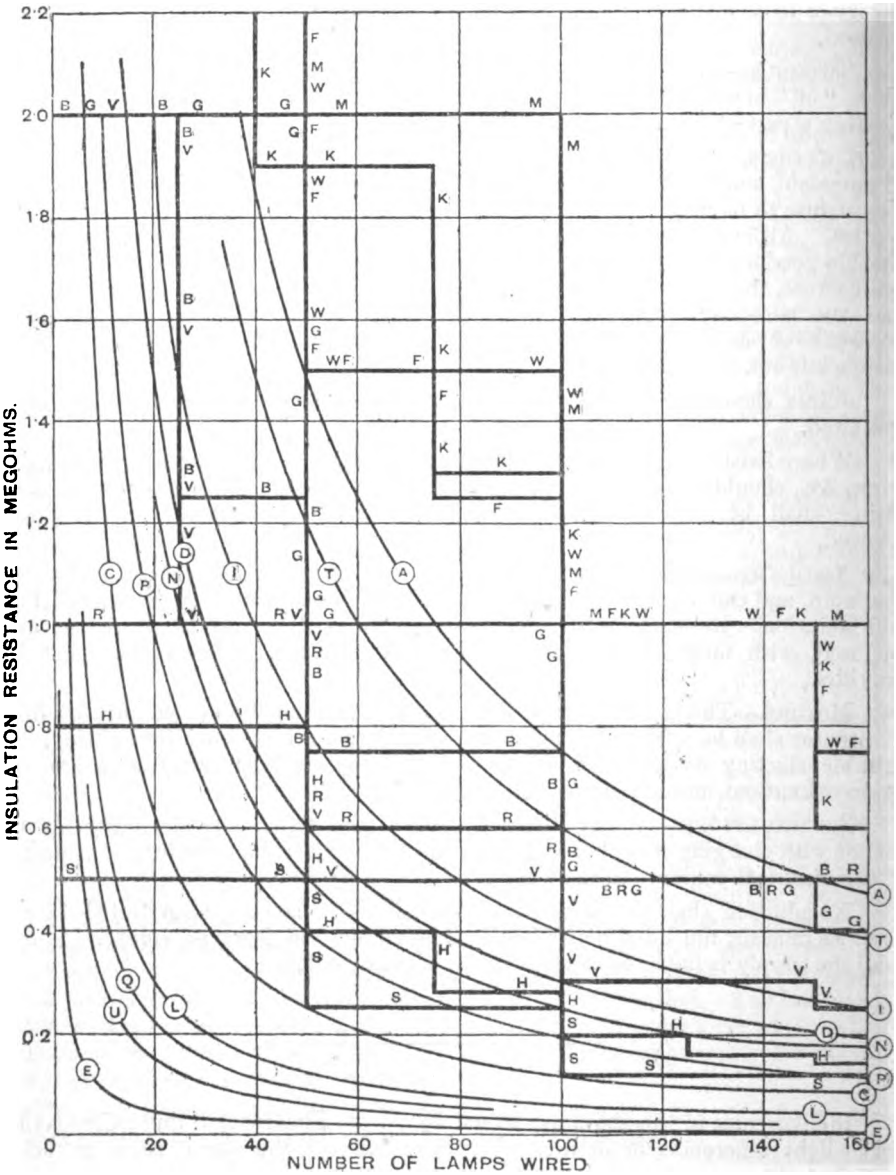
HOUSE-WIRING INSULATION CURVES.

These curves have been plotted from the rules with regard to house-wiring issued by the companies and Corporations mentioned in the accompanying key; further information will be found in *The Electrician* for January 12, 1894.



A, City of London.
B, London Electric and House to House.
C, Phœnix Fire Office, Liverpool Corporation, and Lloyds.
D, Bradford Corporation.
E, Institution of Electrical Engineers.
F, Notting Hill, Kensington and Knightsbridge, and Westminster.
G, Portsmouth Corporation.
H, St. Pancras Vestry.
I, Scarborough.
K, Chelsea.
L, Leading insurance companies.
M, Charing Cross and Strand.
N, Taunton Corporation.
P, Brighton Corporation.
Q, London County Council (theatres).
R, Manchester Corporation.
S, Whitehaven.
T, Glasgow Corporation and Kelvinside.
U, Chambre Syndicale des Industries Electriques.
V, St. James's and Pall Mall
W, Derby Corporation.

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	Electric Light Co.	
Hove	Hove Electric Lighting Company	nd t
Huddersfield	Huddersfield Corporation	A. B. s
Hull	Hull Corporation	A l f ct Gil
Kelvinside	Kelvinside Electricity Company	W. Ict De
Keswick	Keswick Electric Light Company	J. R. s
Kingston	Kingston Corporation	J. E. ct
Larne	Larne Electric Light Company	Arch s
Leamington	Midland Electric Light and Power Company	F. Wnd s
Leeds	Yorkshire House-to-House Electricity Company	Haro es sor
Liverpool	Liverpool Electric Supply Company	A. ct- Hc
Lynmouth	Lynmouth and Lynton Electric Light Company	J. H. ct
Manchester	Manchester Corporation	H. W s an alley
Morecambe	Morecambe Electric Light and Power Company	Andrs Pr
Nelson	Nelson Corporation	Johnct
Newcastle-o.-T.	Newcastle-on-Tyne Electric Supply Company	R. Ces
Newcastle-o.-T.	Newcastle and District Electric Lighting Company	W. Ict
Northampton	Northampton Electric Light and Power Company	W. Hanc ct
Norwich	Norwich Electricity Company	F. Mect
Ogmore Valley	Ogmore Valley Electric Light and Power Company	G. Vts
Oxford	Oxford Electric Company	J. Hts M.
Preston	National Electric Supply Company	J. Hct
Reading	Reading Electric Supply Company	F. Fts
Scarborough	Scarborough Electric Supply Company	G. Sct
Sheffield	Sheffield Electric Light and Power Company	W. Jan (Mts
Southampton	Southampton Electric Light and Power Company	J. Hanc ct
Taunton	Taunton Corporation	Harcts Cc
Weybridge	Weybridge Electric Supply Company	H. C. es
Whitehaven	Whitehaven Town and Harbour Trustees	ct
Woking	Woking Electric Supply Company	C. Toup be

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	formers						
...	Three-wire with batteries	6,237	4,433	1·33	1,874	6½	Bare c
15 Mountain	Alternate-current transformers	10,000	16,500	...	4,500	5½	Bitum
red H. obings	Three-wire with batteries	5,000	9,000	0·78	900	5	Bare co cables cables
lsdon	Two-wire	1,200	5,000	...	...	...	Armo
issue w furth Dixon...	Alternate-current transformers	1,862	2,000	6	3,520	3¾	3½ mile ted c
2·2 Edgcome	Alternate-current transformer substations feeding low-pressure network	2,500	5,000	⅓	2,000	4	Armo
er Turner	High-pressure alternating. One sub-station & five transformers on poles; two-wire to consumers	...	...	...	...	5	Overh
2·0 . E. Jones	Two-wire..	4,000	10,000	1	1,760	2½	Bitumen slate l Yorks
ld Dickin-	Alternate-current transformers	10,865	10,000	33	6,000	8	Insula
1·8 Bromley lmes	Two-wire with batteries.	38,000	45,000	...	...	28	Caller
Bale ...	Alternate-current transformers	1,200	2,500	...	...	...	Lead-c India
1·6 Vooler ...	Five-wire	31,000	40,000	½	1,760	8	Bare co possib iron p
ews and eece, Ltd.	Two-wire	3,000	5,200	...	...	4	Insula in tr
1·4 Foster...	Two-wire	2,000	4,000	1	800	3	India-ru porcel Sub-m
. Jackson	Alternate-current transformers	21,200	...	...	3,520	10	Conce
1·2). Hunter	Alternate-current transformers	18,000	20,000	2	2,000	...	Insula
. Heenan	Two-wire	4,600	7,000	...	900	3	Bare
1·0 . Long ...	Three-wire with batteries	...	5,000	¾	1,250	2¾	Bare 9in.
0·8 Vilson ...	Low-pressure	3,000	5,000	1½	1,700	...	Overh
ardie cLean	High-pressure continuous-current transformers, distribution at 100 volts	7,300	15,000	...	1,000 from Cent. Switch Stn.)	9	Doub lea
0·6 . Tonge...	Three-wire	9,000	20,000	...	800	...	Bare
Yeatman	Alternate-current transformers	1,500	1,400	...	...	...	Overh
0·4 Peck ...	Alt.-cur. trans. in sub-stations sunk under pavements in part of town, otherwise on consumers' premises. 2-wire distribution from sub-stations	4,100	10,000	...	3,500	...	India cas
ohnson n. & Sec.)	Alternate-current transformers, partly in sub-stations and partly in houses, with two-wire distribution to consumers	7,000	9,500	...	1,695	3½	Partly c partly
0·2 . Lee.....	Three-wire with batteries	3,500	4,080	...	785	...	Bare
ld W. uzens	Alternate-current transformer sub-stations with three-wire distribution	2,300	3,100	3	1,200	4	Overhea conce sure c
0 Buchanan	Alternate-current transformers	800	2,400	...	...	6¾	Overh
...	Three-wire	1,200	4,600	1	...	1⅔	Insul pip
urner ...	Alternate-current transformer, sub-stations feeding into two-wire network	3,000	4,000	14	3,500	...	Rubb pip

INSULATION RESISTANCE IN MEGOHMS.

A, City
B, Lon
C, Phe
D, Bra
E, Inst
F, Nott
W
G, Port
H, St. P
I, Scarl
K, Chel

* Exclusive of Parks and Open Spaces.

The following Stations, also in operation, are unable to supply data :—Chatham (Co.), alt.-cu

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6½	Bare copper in culverts	Locomotive	4	...	Davey-Paxman under-type Willans	2 2	170	Belts and direct
5½	Rubber-covered single cables	B. & W.	4	800	Vertical condensing	4	1000	Ropes
5	Bare copper in culverts, rubber insulated cables in iron pipes and bitumen insulated cables in bitumen conduits	Paxman's Economic	3	...	Willans	4	400	Direct
	Armoured cable	B. & W.	2	300	Willans	2	300	Direct
3½	Wires overhead, and ¼-mile insulated cables in iron pipes	Galloway	...	230	Westinghouse Victor turbine	1 1	100	Belts
2	Armoured concentric	Belliss multi-tubular Lancashire type	2	400	Bellis closed type compd.	7	300	Direct
	Overhead.....	Cornish with Galloway tubes	2	...	Horizontal condensing engines, Corliss valve gear	2	100	Ropes
2	Rubber insulated cables supported on insulated bridges in brick culverts covered by Yorkshire flags	Robey	...	...	Robey	...	...	Belts and Ropes
	Insulated cables in iron pipes...	Lancashire	3	...	Compound condensing	3 1	700	Ropes
	Under solid system	Lancashire	13	3900	Willans	19	3800	Direct
	Lead-covered cables in casing and india-rubber cables in pipes	...	...	...	Water-power	2	200	Direct
	Bare copper in concrete culverts where possible, otherwise insulated cables in pipes	Lancashire	6	...	Vertical compound condensing	4 6	1980	Link Belts and Jockey Pulley
	Insulated cables in iron pipes or troughs filled with bitumen	...	...	...	...	...	...	Belts
	India-rubber cables carried on vitrified porcelain bridges in cast-iron conduits. Mains run in glass-lined iron tubing	Lancashire	3	...	Willans	2	210	Direct
	Concentric cables in iron pipes	Lancashire	5	1250	Horizontal compound triple gear to valves one vert. compound	5	1100	Ropes
	Insulated cables in iron pipes...	Lancashire	5	...	Parsons turbine	7	...	Direct
	Bare copper in conduits.....	Daniel Adamson	3	...	Scott & Hodgson	3	...	Ropes and direct
	Bare copper in culverts, and in 4 and 6in. earthenware pipes	B. & W.	3	...	Willans	3	300	Direct
	Overhead bare copper	Tubular	2	140	Fowler compound. Robey compound.	1 1	140	Belts
	Double steel armoured mains, lead-covered	Loco.	3	800	Triple expans. marine surface condensing	3	600	Belts
	Bare copper.....	Lancashire	5	1250	Belliss open compound	8	710	Direct
	Overhead cables	B. & W. Loco.	2 1	195	Armington-Sims .... Browett and Lindley Westinghouse	1 2 2	160	Belts
	India-rubber covered cables in cast-iron pipes	Lancashire	2	...	Condensing Parsons' steam turbines	2	400	Direct
	Concentric cables in iron pipes, and paper bitumen solid in iron casing	Water tube	5	1500	Vertical ..... Horizontal ...	4 1	650	Ropes and Belts
	Bare copper in culverts	Loco. Lancs.	2 1	260	Willans ..... Robey	2 1	280	Belts and direct
	Lead wires for high pressure; triple concentric (underground) for low pressure distribution	Babcock and Wilcox Davey Paxman "Economic"	2 1	330	Willans ..... Ruston Proctor .... Bumsted & Chandler	2 2 1	440	Belts
	Overhead.....	B. & W. Loco.	1 1	210	Vertical compound	2	150	Ropes
	Insulated cables in earthenware pipes	Lanc. with Galloway tubes	2	500	Willans	4	240	Direct
	Rubber cables in porcelain pipes	Tubular	4	250	Vertical high-speed triple ex. and compound Corliss	4	250	Direct-coup and link be

† Not revised up to date.

...current; Ipswich (Co.); Killarney (Co.), alt.-current; Thetford (Co.), low-pressure; St. Austell (Co.)

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	Crompton ...	4	132	8d.	2/9	The charge per B.T.U. subject to discount.
	Mordey	4	500	6d.	2/9	Primary mains concentric.
	Siemens	4	320	7d.	2/10	...
	Goolden	2	150	8d.	2/6	...
	Kapp	2	60	...	3/3	Also a 50-H.P. "Victor" turbine. Contracts made with customers based on gas bills.
	Siemens	3	195	6d.	3/–	The boilers are fed by mechanical stokers using inland small coal at 12s. 6d. per ton; there are also two Siemens arc lighters.
	Mordey	2	50	6d.	4/7	Public lighting by 11 arc lamps and 66 incandescents.
	Chamberlain & Hookham	5	225	8d. 4d.	2/6 3/0	...
	Lowrie-Parker	3	350	8d.	2/4	B.T.U. discount 10% to 25% and 5% for cash. Gas less 5% for cash.
	Siemens .... Elwell-Parker	19	2000	7½d.	3/4	...
	Mordey	2	75	...	...	Lamps charged for by contract, 20s. per 16 c.p. lamp per annum.
1 3	Edison-Hopkinson Elwell-Parker.....	4 6	1420	8d.	2/6	With rebate when the electrical consumption is over 480 hours per ann. of supply demanded.
	...	5	120	7d.	3/11	Three generators for Dowson gas, and five gas engines of a total of 260 h.p.
	Holmes and Siemens	3	140	5d.	2/6	Present generation is by waste heat from the gas retorts.
	Mordey	5	600	4½d.	...	...
	...	...	...	6d.	1/10	Gas less 10 %. The maximum charged is less a discount varying from 5 to 25 %. The station also runs 60 arcs.
1	Crompton ...	3	200	8d.	2/4	Discount of 5%.
	"Norwich" ...	3	180	8d. 4d.	3/8	The price is 8d. per B.T.U. for the period from one hour before sunset to eight p.m. on week days, and seven p.m. on Sundays, and 4d. per B.T.U. for all the rest of the day and night.
	Wilson.....	6	72	6d.	...	To be erected, two 40-H.P. Pelton wheels.
	Parker.....	3	240	8d.	3/4	High-pressure mains seven miles in length, insulated cables in iron pipes. Discount of 5 per cent. for monthly payments.
	"Westminster"	8	470	6d.	3/1¼	...
	Thomson-Houston	2	36	8d.	3/-	There are about 90 1,200-c.p. arc lamps supplied to shops, &c., the current being supplied by four T.-H. arc lighters.
	Parsons	2	300	5¾d. to 6¼d.	2/10	...
1	Mordey	4	300	6d.	2/- 2/3	Also series arc machines of 150-light capacity (140 lights in use). Station reconstructed during 1893.
	Crompton.....	4	155	6d.	2/10 3/4	The figure given for plant capacity includes plant for driving two electric cranes. B.T.U. (with rebate on sliding scale), 7d.; 6d. for power.
	Thomson-Houston	3	165	6d.	4/6 less dis. 3/9	Station in process of reorganisation. There are at present 78 arcs running.
	Thomson-Houston	...	...	9d.	4/9	Street lighting: 119 20-c.p. Thomson-Houston lamps.
	Crompton.....	4	144	30/- and 2d.	3/6	All the streets in district lighted with (502) glow lamps of from 8-c.p. to 100-c.p. on 2-wire system at 240 volts, 2 lamps in series.
l'd lts	Mordey, Mather and Platt	4	180	8d.	5/-	Local Board have just accepted tender for street lighting.

low-pressure.

[SEE OVER.

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THE ELECTRIC RAILWAYS AND TRAMWAYS OF THE UNITED KINGDOM.

Place.	Length.	System.	Worked by.
In Operation :—	Miles.		
Bessbrook—Newry	3¼	Third Rail (Dr. E. Hopkinson)	Bessbrook and Newry Tramway Company.
Birmingham	3	Accumulator Cars	Birmingham Central Tramways Company.
Blackpool	2	Holroyd - Smith's Conduit	Blackpool Corporation.
Brighton	1	Third Rail (Volk)	Mr. Magnus Volk.
Carstairs	1¼	Anderson-Munro	Mr. J. Monteith, of Carstairs (Private).
City and South London Railway (King William-street—Stockwell)	3¼	Third Rail (Dr. E. Hopkinson)	City and South London Railway Company.
Douglas — Grondle Glen (Isle of Man)	2⅓	Under-Running "Bar" Trolly (Dr. E. Hopkinson)	...
Guernsey	2¾	Overhead (Siemens).....	Guernsey Railway Company.
Leeds (Roundhay Park Line)	3¾	Thomson-Houston Overhead Trolley	Thomson - Houston International Electric Company.
Liverpool Overhead Railway	6¼	Third Rail.....	Liverpool Overhead Railway Company
Portrush — Giant's Causeway	8	Third Rail (Siemens) ...	Giant's Causeway Electric Tramway Company.
Ryde	¾	Third Rail (Siemens) ...	Ryde Pier Company.
Southend Pier	1¼	Third Rail (Crompton)...	Southend Corporation.
Walsall, Wednesbury, Bloxwich, and Darlaston	7½	Overhead Side Trolley...	South Staffordshire Tramways Company.
In Progress :—			
Coventry	5¾	Thomson-Houston Overhead Trolley	Coventry Electric Tramways Company.
Grondle Glen—Laxey (Isle of Man)	4⅔	Under-Running "Bar" Trolley (Hopkinson)	...
Projected :—			
Barry Island	...	...	Barry Docks Railway Company.
Blackpool—Lytham	...	...	...
Bolton	...	...	Bolton Corporation.
Brecon	...	...	Brecon Corporation.
Brighton—Rottingdean ...	...	...	Brighton and Rottingdean Seashore Railway Company.
Wellingborough and District Tramroads	2½	...	Wellingborough and District Tramways Company.
Wigan	5½	...	Wigan Corporation.
London—			
Central London Railway (City and Shepherd's Bush)	6½	...	Central London Railway Company.
City and South London Railway Extensions—			
Clapham	1	Third Rail (Dr. E. Hopkinson)	City and South London Railway Company.
Islington	2¾		
Finsbury Park and City...	3¼	...	...
Finsbury—Walthamstow..	...	...	...
Hampstead, St. Pancras & Charing Cross	5¼	...	...
Waterloo—Baker-street...	3	...	...
Waterloo—City	1½	...	South-Western Railway Co.

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PROVISIONAL ORDERS AND LICENCES GRANTED BY THE BOARD OF TRADE DURING 1893.

PROVISIONAL ORDERS.—METROPOLITAN.

Title of Order.	To whom Granted.	Area Covered by Order.
Hackney Electric Lighting Order	Board of Works	District of Hackney Board of Works.
Hammersmith Electric Lighting Order	Vestry	Parish of Hammersmith.
Islington Electric Lighting Order	Do.	Parish of St. Mary, Islington.
Poplar Electric Lighting Order	Board of Works	District of Poplar Board of Works.

PROVINCIAL.

Altrincham and Bowdon Electric Lighting Order	Manchester Edison-Swan Company Limited.	Local Board Districts of Altrincham and Bowden, and a portion of District of Rural Sanitary Authority for the Altrincham Union.
Barnet Local Board Electric Lighting Order	Local Board	District of Barnet Local Board.
Beckenham Electric Lighting Order	Do.	Portion of the Parish of Beckenham.
Bridgend Electric Lighting Order	Do.	Urban Sanitary District of Bridgend.
Colchester Electric Lighting Order	Corporation	Borough of Colchester.
Eccles Electric Lighting Order	Do.	Municipal Borough of Eccles.
Newcastle-upon-Tyne Electric Lighting Order	Newcastle-upon-Tyne Electric Supply Company, Limited.	City and County of Newcastle upon-Tyne.
Newmarket Electric Lighting Order	British Electric Light Company, Ltd.	Urban Sanitary District of Newmarket.
Partick Electric Lighting Order	Commissioners of Police	Burgh of Partick.
Reading Electric Supply Order	Reading Electric Supply Co., Ltd.	Borough of Reading.
Taunton (Corporation) Electric Lighting Order	Corporation	Municipal Borough of Taunton and a portion of the District of the Taunton Union Rural Sanitary Authority.

LICENCES

Name of Local Authority or Company.	Area of District.
Pontypool Electric Light and Power Company, Limited	District of the Pontypool Local Government Board.
Corporation of Taunton *(Provisional Order since granted)*	Municipal Borough of Taunton.

The Board of Trade have approved of the transfer of the Orders obtained in 1890 by the Corporation of Cambridge to the Cambridge Electric Supply Company, Limited, and by the Hove Commissionerr to the Hove Electric Lighting Company, Limited.

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ELECTRIC LIGHTING NOTICES FOR 1894.

The following is a list, corrected up to date, of the Electric Lighting Notices of Application to the Board of Trade for Provisional Orders for 1894. It will be seen that there are 26 notices as against 18 last year.

THE METROPOLIS.

Districts.	Names of Applicants.
Portions of Beckenham, Croydon, Lambeth, Lewisham, & Camberwell.	Crystal Palace District Electric Supply Company.

THE PROVINCES.

Aberdare.....	J. C. Howell (Limited).
Barrow-in-Furness	Corporation.
Bedford	Bedford Electric Light Company.
Birmingham ...	Birmingham Electric Supply Company.
Buxton	Local Board.
Chelmsford.....	Crompton and Co.
Chepping and Wycombe ...	Corporation.
Chesterfield ...	Corporation.
Clonmel	Corporation.
Grimsby	Corporation.
Guildford ...	Holloway Electricity Supply Company.
Harrow	Local Board.
Leyton.....	Local Board.
Monmouth	Corporation.
Moss Side	Collier-Marr Telephone and Electrical Manufacturing Company.
Oswestry.....	Oswestry Electric Lighting and Power Company.
Peterborough ...	Corporation.
Plymouth	Corporation.
St. Austell	Veale and Co. (Limited).
St. Helens	Corporation.
Shrewsbury.....	Shropshire Electric Light and Power Company.
Stirling	Caledonian Electric Supply Company.
Wakefield	Corporation.
West Hartlepool	Corporation.
Yeadon	Local Board.

ELECTRIC TRACTION NOTICES FOR 1894.

Names of Applicants.	Powers Sought.
Abergele and Pensarn Pier Company (Limited)	Construction of tramway. Use of electricity or other motive power.
Barrow-in-Furness Corporation	Construction of tramways. Use of electricity or other motive power.
Bristol Tramways and Carriage Company (Limited)	Construction of tramways. Use of electricity or other motive power.
Central London Railway.	Extension of time.
Company to be formed...	Construction of railway (partly underground) from South-place, Finsbury, to Walthamstow and Epping Forest. Use of electricity and steam or other motive power.
Croydon Corporation ...	Construction of tramways. Use of electricity or other motive power.
Croydon Tramways Company	Construction of tramways in Croydon and Streatham. Use of electricity or other motive power (except steam).
Dudley and Wolverhampton Tramways (Limited)	Construction of tramways in Dudley and Wolverhampton, and from Wolverhampton to Bilston. Use of electricity or other motive power.
Hull Street Tramways Company	Power to transfer part of undertaking. Use of electricity or other motive power.
Liverpool Corporation ...	Construction of tramways. Use of electricity or other motive power.
Liverpool United Tramways and Omnibus Company	Construction of tramways in Bootle and Walton-on-the-Hill. Use of electricity or other motive power.
South Staffordshire Tramways Company	Construction of tramways in West Bromwich and Handsworth. Use of electricity or other motive power.
West London Tramways Company (Limited)	Construction of tramways in Acton, Hammersmith and Fulham. Use of mechanical power.

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NEW PUBLIC COMPANIES OF 1893.

The following are the more important limited liability electrical and engineering companies registered during the past year, together with their capital:—

	Capital.
Acme and Immisch Electric Works	£25,000
Adams George) and Sons	100,000
Aladdin Primary Electric Battery Company	5,000
American River Electric Power Supply Company	25,000
Anders Telephone Company	10,000
Arrol (Sir William) and Co.	150,000
Baily, Grundy and Barrett	10,000
Baily and Grundy, London	10,000
Banks (William) and Co.	4,000
Belliss (G. E.) and Co.	150,000
Bourne and Grant Electricity Supply Company	25,000
British Volta Electric Glow Lamp Company	2,000
Caledonian Electric Supply Company	100
Canterbury Electricity Company	50,000
Chemical and Electrolytic Syndicate	30,000
Clarke, Chapman and Co.	150,000
Coventry Electric Tramways	25,000
Credenda Tube Company	100,000
Dalziel's Atlantic Telegram Company	25,000
Dawson, Roger	15,000
Dempster, R. and J.	100,000
District Messenger Company of Paris	200,000
Domestic Telephone Company	20,000
Dover Electricity Company	50,000
Edinburgh Tramways Company	125,000
Electric and Automatic Engineering Company	10,000
Electric Anti-Corrosion Company	6,000
Electric Construction Company	400,000
Electric Light Regulating Syndicate	1,000
Electric Semaphore Signal Syndicate	3,000
Electrolytic Separation Syndicate	25,000
Electro-Protector Syndicate	10,000
English Electric Carbon Company	10,000
English Electric Manufacturing Company	5,000
Europe and Azores Telegraph Company	200,000
Faraday Electrical Engineering Company	4,600
Ford-Lloyd Manufacturing Company	10,000
General Electrolytic Parent Company	24,000
Gordon and Fell	100,000
Gorseinon Electric Light Company	1,000
Gravier Dynamo Syndicate	10,000

	Capital.
Harrison, Ainslie and Co.	£100,000
Harvey Steel Company of Great Britain	180,000
Herculite and Electrical Manufacturing Company	12,000
Holcroft (Thomas) and Sons	120,000
Incandescent Electric Lamp Company	25,000
Lamina Accumulator (Elieson's British Patents) Syndicate	12,000
London and Lancashire Electric and General Engineering Co.	20,000
Marchent, Young and Co.	4,000
Mazarron Electric Light Company	15,000
Merionethshire Electric Lighting, Power and Appliance Co.	3,000
Merveilleuse Electric Arc Lamp Syndicate	15,000
Moritz, George	5,000
New Panulcillo	50,000
Newington, Priddle and Co.	7,000
North-Eastern Telephone Company	1,000
Omnibus and Tramcar Electric Lighting Company	60,000
Orme's Electric Signal Syndicate	7,500
Oswestry Electric Lighting and Power Company	10,000
Pioneer Electric Carriage Company	20,000
Printing, Telegraph & Construction Company of the Agence Havas	130,000
Pyke, Harris and Co.	30,000
Ransome (A.) and Co.	59,000
Ramsden, Camm and Co.	50,000
Redruth Electric Supply Company	10,000
Robey & Co.	300,000
Robinson (Thomas) and Son	120,000
Rugby School Electric Lighting Company	5,500
St. Martin's Electrical Manufacturing Company	500
St. Nicholas Construction Company	40,000
Salt Lake and Ogden Gas and Electric Light Company	300,000
Saxby and Farmer	25,000
Stannum Metal Company	40,000
Stephens and Co.	20,000
Statter (J .G.) and Co.	20,000
Swinburne and Co.	25,000
United Gutta-Percha and Rubber Company	50,000
Universal Electric Lighting Company	5,000
Wallis and Steevens	60,000
Waterhouse Electrical Manufacturing Company	20,000
Waterhouse Electro-Metric Syndicate	20,000
Zohrab and Bigg's English Patents	32,007

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PUBLIC COMPANIES WOUND UP, DISSOLVED, &c., IN 1893.

The following are amongst the limited liability companies which have been wound up during the past year, the asterisk denoting that the company was wound up by order of the Court :—

Abell's Electrical Engineering Company.
Aladdin Primary Battery.
Arcas Plating Company.
*Art Workshops.
Birmingham Telegraph Factory.
Blakey, Emmott and Co.
Boy Messengers and Electric Call Company (business taken over by the District Messenger Service and News Company).
British Electrical Installation Contractors (business taken over by the New British Electrical Installation Contractors).
British Tanning Company.
Edinburgh Electric Supply Corporation.
Electrical Supplies and Fittings Company.
*Elmore's French Patent Copper Depositing Company.
Electrical Engineering Company of Ireland.
Electric Construction Corporation (business taken over by the Electric Construction Company).
Engineering Exchange.
Foreign Electric Date and Time Stamp Company (new Company formed with same name).
Fowler, Lancaster and Co.
Freedman Battery Company.
Gordon (J. E. H.) and Co.
Halifax Mutual Electric Light and Power Company.
Law's Electrical Appliances Company.
*London Metallurgical Company.
London Battery Company.
*Mountain's Wire Manufacturing Company.
Nottingham Electric Light and Power Company.
Panulcillo Copper Company (business taken over by the New Panulcillo).
Powditch (J. R.) and Co.
Taunton Electric Lighting Company.
Telephone Company of Ireland (business taken over by the National Telephone Company).
Telephone Company of Austria (the Company's Exchanges having been taken over by the Austrian Government).
Wenham Company.
Williamson Electrical Engineering Company.
Windsor and Eton Electric Lighting Company.
*Woodhouse and Rawson United.

The following companies have been dissolved or have ceased to exist, in most cases nothing having been done beyond registration, and no business having been commenced :—

Automatic Electrical Corporation.
Canterbury Electricity Supply Company.
Cardiff Electricity Supply Company.
Douglas Patent Block and Electric Meter Company (business taken over by the Electric Meter Company).
Dover Electricity Supply Company.
Electrical Works Construction and Maintenance Company.
Electrical Standardising, Testing, and Training Institution.
Electro-Automatic Fire Extinguishing Company.
Electric Anti-Corrosion Company.
Gloucester Electricity Supply Company.
Gordon and Fell.
Kingston-upon-Hull Electric Lighting Supply Company.
Lane Fox Electrical Company.
Leicester Electric Light and Power Company.
Loughborough Electricity Supply Company.
Manchester Electricity Supply Company.
Penzance Electricity Supply Company.
Portland Electric Light Company.
Provincial Electric Light and Power Supply.
Putney and Hammersmith Electric Light and Power Supply.
Redruth Electric Supply Company.
Stoke-on-Trent Electricity Company.
Theatre Electrical and Specialities Production Company.
Weston-Super-Mare Electricity Supply Company.
Weymouth Electricity Supply Company.

The following changes in nomenclature have been made :—

Charing Cross and Strand Electricity Supply Corporation—formerly the Electricity Supply Corporation.
Hobart Electrical Tramways Company—formerly the Hobart Tramways Company.
Okonite Company - formerly the International Okonite Company.

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MR. W. H. PREECE'S FUSE TABLES.

GIVING THE SIZES OF VARIOUS WIRES WHICH WILL BE FUSED BY A GIVEN CURRENT.

Current in Amperes.	Tin Wire.		Lead Wire.		Copper Wire.		Iron Wire.	
	Diameter Inches.	Approx. S.W.G.	Diamete Inches.	Approx. S.W.G.	Diameter Inches.	Approx. S.W.G.	Diameter Inches.	Approx. S.W.G.
1	0·0072	36	0·0081	35	0 0021	47	0 0047	40
2	0·0113	31	0·0128	30	0·0034	43	0·0074	36
3	0·0149	28	0·0168	27	0·0044	41	0·0097	33
4	0·0181	26	0·0203	25	0·0053	39	0·0117	31
5	0·0210	25	0·0236	23	0·0062	38	0·0136	29
10	0·0334	21	0·0375	20	0·0098	33	0·0216	24
15	0·0437	19	0·0491	18	0·0129	30	0·0283	22
20	0·0529	17	0·0595	17	0·0156	28	0·0343	20·5
25	0·0614	16	0·0690	15	0·0181	26	0·0398	19
30	0 0694	15	0·0779	14	0·0205	25	0·0450	18·5
35	0·0769	14·5	0·0864	13·5	0·0227	24	0·0498	18
40	0·0840	13·5	0·0944	13	0·0248	23	0·0545	17
45	0·0909	13	0·1021	12	0·0268	22	0·0589	16·5
50	0·0975	12·5	0·1095	11·5	0·0288	22	0·0632	16
60	0·1101	11	0·1237	10	0·0325	21	0·0714	15
70	0·1220	10	0·1371	9·5	0·0360	20	0·0791	14
80	0·1334	9·5	0·1499	8·5	0·0394	19	0·0864	13·5
90	0·1443	9	0·1621	8	0·0426	18·5	0·0935	13
100	0·1548	8·5	0·1739	7	0·0457	18	0·1003	12
120	0·1748	7	0·1964	6	0·0516	17·5	0·1133	11
140	0·1937	6	0·2176	5	0·0572	17	0·1255	10
160	0·2118	5	0 2379	4	0·0625	16	0·1372	9·5
180	0·2291	4	0·2573	3	0·0676	16	0·1484	9
200	0·2457	3·5	0·2760	2	0·0725	15	0·1592	8
250	0·2851	1·5	0·3203	0	0·0841	13·5	0·1848	6·5

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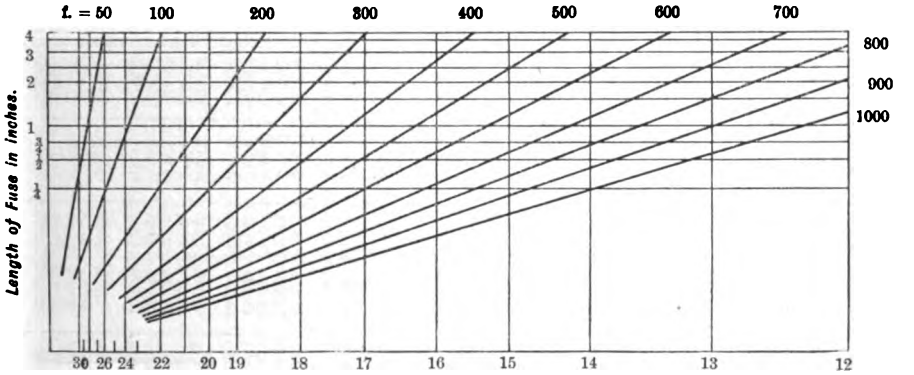
FUSE CONSTANTS AND SPARKING DISTANCES.

If for any set of terminals the fusing current for a fuse-wire of given length, diameter, and material, be known, the current necessary to fuse a wire of any other length or diameter, but of the same material, and clamped between the same terminals, may be found as the product of two constants. One of these depends on the material and the size of the terminals, and the other on the length and diameter of the wire. The first of these is given below, for six metals.

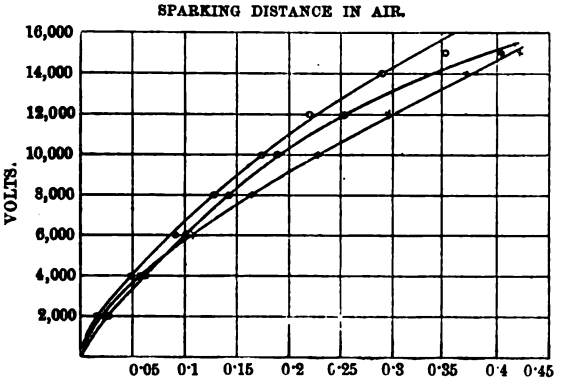
Constants for various metals for Terminals of medium size :—

Copper	0·47	Iron	0·15
Platinum	0·24	Tin	0·08
Platinoid	0·22	Lead	0·06

The second constant may be found from the following diagram. The ordinates give the length of fuse in inches, and the abscissæ give the number of the fuse-wire in Standard Wire Gauge. The diagram has been re-arranged from one devised by Mr. C. P. Feldmann.



In connection with fuses, the following curves of sparking distance in air will be found useful. They are based upon Mr. A. Siemens' experiments, the distance being given in decimals of an inch.



Readings :—•, between two Discs ; o, Hemisphere and Disc ; ×, Point and Disc ; in decimals of an inch.

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IMPERIAL OR BOARD OF TRADE STANDARD WIRE GAUGE.

Table of Relative Dimensions, Lengths, Weights, and Resistances of Pure Copper Wire *

By H. G. CHEESMAN, Eastern Telegraph Company.

No. of B.T.W. Gauge.	Diameter.		Area.				Weight and Length.—Sp. gr. 8·90.						Resistance as Pure Copper at 15·5° C. or 59·9 F.						No. of B.T.W. Gauge.
	Inchs	Millms.	Circular mils. (d^2) 1 mil. = ·001in.	Circular mm. (d^2)	Square in. ($d^2 \times$ ·7854)	Square mm.	Grains per foot.	lbs. per 1,000 feet.	Grmms. per metre.	Feet pr lb.	Yards per lb.	Metres per gramme.	Ohms per 1,000 feet.	Feet per Ohm.	Ohms per metre.	Metres per ohm.	Ohms per lb.	Ohms per kilogm.	
0000000	0·500	12·700	250000·	161·290	·19635	126·68	5294·0	756·28	1127·4	1·3223	0·44076	0·000887	0·040216	24863·	0·00013194	7579·0	·000053175	·0002412	0000000
000000	·464	11·705	215296·	138·866	·169093	109·09	4559·2	651·31	970·9	1·5355	0·51185	·001030	0·046699	21414·	·00015321	6526·9	·000071700	·00032523	000000
00000	·432	10·973	186624·	120·400	·146574	94·562	3951·1	564·44	841·6	1·7717	0·59056	·001188	0·053886	18558·	·00017679	5656·4	·000095468	·00043304	00000
0000	·400	10·160	160000·	103·225	·125664	81·072	3388·2	484·03	721·54	2·0660	0·68866	·0013859	0·062837	15915·	·00020621	4850·6	·000129s2	·00058886	0000
000	·372	9·4487	138384·	89·278	·1086868	70·119	2930·4	418·63	624·06	2·3887	0·79623	·0016024	0·072653	13764·	·00023836	4195·2	·00017355	·00078722	000
00	·348	8·8371	121104·	78·094	·095115	61·335	2564·6	366·36	545·88	2·7296	0 90986	·0018319	0·083020	12018·	·00027238	3671·4	·00022661	·0010279	00
0	324	8·2295	104976·	67·724	·0824481	53·191	2223·0	317·54	473·41	3·1489	1·0499	·0021124	0·095774	10441·	·00031422	3182·5	·00030158	·0013680	0
1	·300	7·6200	90000·	58·064	·070686	45·603	1905·8	272·27	405·87	3·6730	1·2245	·0024630	0·11171	8951·7	·00036651	2728·4	·00041030	·0018611	1
2	·276	7·0103	76176·	49·145	·0598286	38·598	1613·1	230·44	343·52	4·3394	1·4464	·0029110	0·13199	7577·0	·00043303	2309·4	·00057274	·0025979	2
3	·252	6·4008	63504·	40·970	·049876	32·178	1344·8	192·11	286·38	5·2053	1·7351	·0034919	0·15832	6316·3	·00051943	1925·2	·00082411	·0037381	3
4	·232	5·8927	53824·	34·724	·0422733	27·273	1139·8	162·83	242·72	6·1415	2·0471	·0041199	0·18680	5353·5	·00061285	1631·7	·0011472	·0052036	4
5	·212	5·3847	44944·	28·996	·0352990	22 773	951·74	135·96	202·68	7·3549	2·4516	·0049339	0·22370	4470·3	·00073393	1362·5	·0016453	·007463	5
6	·192	4·8768	36864·	23·783	·0289529	18·679	780·64	111·52	166·24	8·9670	2·9890	·0060153	0·27273	3666·6	·00089480	1117·6	·0024455	·011063	6
7	·176	4·4703	30976·	19·984	·0243285	15·695	655·93	93·708	139·69	10·672	3·5573	·0071587	0·32458	3080·9	·0010649	939·07	·0034637	·015711	7
8	·160	4·0640	25600·	16·516	·0201062	12·980	542·11	77·445	115·44	12·915	4·3050	·0066621	0·39273	2546·3	·0012885	776·09	·0050711	·023002	8
9	·144	3·6576	20736·	13·378	·0162860	10·507	439·11	62·730	93·511	15·941	5·3137	·010694	0·48486	2062·5	·0015908	628·63	·0077293	·03506	9
10	·128	3·2512	16384·	10·570	·0128679	8·3018	346·95	49·565	73·886	20·176	6·7253	·013533	0·61365	1629·6	·0020087	496·70	·012381	·056159	10
11	·116	2·9463	13456·	8·6412	·0105683	6·7868	284·95	40·707	60·403	24·566	8·1886	·016556	0·74718	1338·3	·0024514	407·93	·018355	·083257	11
12	·104	2·6416	10816·	6·9779	·00849488	5·4804	229·04	32·720	48·329	30·562	10·187	·020692	0·92955	1075·8	·0030497	327·9	·028409	·12885	12
13	0·092	2·3368	8464·	5·4605	·00664762	4·2887	179·24	25·605	38·186	39·055	13·018	·026199	1·1878	841·85	·0038972	256·59	·046391	·21043	13
14	·080	2·0320	6400·	4·1290	·00502656	3·2429	135·53	19·361	28·862	51·649	17·216	·034648	1·5709	636·57	·0051540	194·03	·081139	·36804	14
15	·072	1·8288	5184·	3·3444	·00407151	2·6267	109·78	15·683	23·378	63·765	21·255	·042775	1·9394	515·62	·0063630	157·16	·12367	·56095	15
16	·064	1·6256	4096·	2·6426	·00321699	2·0754	86·738	12·391	18·471	80·703	26·901	·054138	2·4546	407·40	·0080532	124·18	·1989	·89354	16
17	·056	1·4224	3136·	2·0232	·00246301	1·5890	66·408	9·4869	14·142	105·41	35·136	·070711	3·2060	311·92	·010518	95·071	·33794	1·5329	17
18	·048	1·2192	2304·	1·4864	·00180956	1·1675	48·796	6·9700	10·390	143·47	47·823	·096236	4·3637	229·17	·014350	69·848	·62607	2·8399	18
19	·040	1·0160	1600·	1·0323	·00125664	·81076	33·882	4·8403	7·2158	206·60	68·866	·13859	6·2837	159·14	·020616	48·506	1·3284	6·0258	19
20	·036	0·91439	1296·	·83611	·00101787	·65668	27·444	3·9206	5·8445	255·06	85·020	·17110	7·7577	128·90	·025452	39·289	1·9787	8·9752	20
21	·032	·81280	1024·	·66063	·00080425	·51886	21·685	3·0978	4·6861	322·81	107·601	·21655	9·8184	101·85	·032213	31·044	3·1695	14·377	21
22	·028	·71119	784·	·50580	·00061575	·39725	16·602	2·3708	3·5355	421·81	140·60	·28284	12·824	77·979	·042074	23·768	5·4116	24·547	22
23	·024	·60960	576·	·37161	·00045239	·29186	12·226	1·7425	2·5975	573·89	191·29	·38498	17·455	57·291	·057267	17·462	10·017	45·438	23

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24	·022	·55880	484·	·32697	·00038013	·25680	10·249	1·4642	2·2855	682·98	227·66	·43754	20·773	48·140	·068153	14·673	14·187	64·352	24
25	·020	·50800	400·	·25806	·00031416	·20268	8·4705	1·2100	1·8034	826·40	275·46	·55450	25·135	39·785	·082465	12·126	20·772	94·218	25
26	·018	·45720	324·	·20903	·00025446	·16417	6·8611	0·98015	1·4612	1020·3	340·10	·68441	31·031	32·226	·10181	9·8224	31·659	143·27	26
27	·0164	·41656	268·96	·17352	·000211241	·13628	5·6955	·81365	1·2129	1229·0	409·66	·82447	37·381	26·751	·12265	8·1538	45·943	208·40	27
28	0148	·37592	219·04	·14131	·000172034	·11099	4·6384	·66263	·98779	1509·1	503·03	1·0123	45·90	21·787	·15059	6·6404	69·270	314·2	28
29	·0136	·34544	184·96	·11933	·000145267	·093719	3·9167	·55953	0·83391	1787·2	595·73	1·1992	54·358	18·397	·17834	5·6072	97·148	440·66	29
30	·0124	·31496	153·76	·098865	·000120763	·077910	3·2561	·46515	·69340	2149·9	716·63	1·4422	65·388	15·294	·21453	4·6614	140·57	637·63	30
31	·0116	·29464	134·56	·086811	·000105633	·068181	2·8495	·40707	·60681	2456·6	818·86	1·6479	74·718	13·384	·25414	4·0793	183·55	832·57	31
32	·0108	·27432	116·64	·075250	·000091609	·059102	2·4700	·35286	·52600	2834·1	944·70	1·9012	86·197	11·602	·28280	3·5360	244·29	1108·0	32
33	·0100	·25398	100·00	·064515	·000078540	·050670	2·1176	·30252	·45090	3305·6	1101·8	2·2175	100·541	9·9463	·32986	3·0316	332·34	1507·5	33
34	0·0092	·23368	84·64	·054605	·000066476	·042887	1·7924	·25605	·38169	3905·5	1301·8	2·6199	118·79	8·4185	·38972	2·5659	463·91	2104·3	34
35	·0084	·21336	70·56	·045521	·000055418	·035752	1·4942	·21346	·31820	4684·8	1561·6	3·1427	142·49	7·0181	·46748	2·1391	667·53	3027·9	35
36	·0076	·19304	57·76	·037264	·000045365	·029267	1·2231	·17473	·26047	5723·0	1907·6	3·8391	174·07	5·7449	·57108	1·7511	996·18	4518·6	36
37	·0068	·17272	46·24	·029832	·000036316	·023430	0·9792	·13988	·20853	7148·8	2382·9	4·7956	216·94	4·5991	·71336	1·4018	1554·4	7050·5	37
38	·0060	·15240	36·00	·023225	·000028274	·018241	·7623	·10891	·16235	9182·2	3060·7	6·1597	279·28	3·5087	·91627	1·0914	2564·4	11632·	38
39	·0052	·13208	27·04	·017445	·000021237	·013701	·5726	·081801	·12194	12225·	4075·0	8·2008	371·82	2·6895	1·2199	0·81974	4545·4	20617·	39
40	·0048	·12198	23·04	·014864	·000018095	·011674	·4879	·069700	·10390	14347·	4782·3	9·6245	436·37	2·2916	1·4317	·69848	6260·8	28399·	40
41	·0044	·11176	19·36	·012490	·000015205	·0098097	·4099	·058567	·087306	17074·	5691·2	11·454	519 32	1·9256	1·7038	·58692	8867·0	40221·	41
42	·0040	·10160	16·00	·010322	·000012566	·0081259	·3388	·048402	·072154	20660·	6886·6	13·859	628·37	1·5915	2·0616	·48056	12982·5	58886·	42
43	·0036	·09144	12·96	·008361	·000010179	·0065668	·2744	·039205	·058445	25506·	8502·0	17·110	775·77	1·2890	2·5458	·39289	19786·9	89752·	43
44	·0032	·08128	10·24	·006606	·0000080425	·0051886	·2168	·030978	·046179	32282·	10760·	21·655	981·83	1·0180	3·2213	·31044	31694·9	143770·	44
45	·0028	·07119	7·84	·005058	·0000061575	·0039725	·1660	·023708	·035355	42181·	14060·	28·284	1282·4	0·77979	4·2074	·23768	54116·1	245470·	45
46	·0024	·06096	5·76	·003716	·0000045239	·0029186	·1223	·017425	·025975	57389·	19129·	38·498	1745·5	·5729	5·7267	·17462	100171·5	454380·	46
47	·0020	·05080	4·00	·002581	·0000031416	·0020268	·0847	·012100	·018034	82640·	27546·	55·450	2513·5	·3978	8·2465	·12126	207719·0	942180·	47
48	·0016	·04064	2·56	·001652	·0000020106	·0012980	·0542	·007744	·011544	129150·	43050·	86·621	3927·3	·2546	12·885	·077608	507010·0	2300300·	48
49	·0012	·03048	1·44	·000929	·0000011310	·0007466	·0305	·004356	·0064939	229560·	76520·	153·99	6982·0	·14323	22·907	·043655	1602799·	7370000·	49
50	·0010	·02540	1·00	·0006451	·0000007854	·0005067	·0211761	·0030252	·0045096	330560·	110186·	221·75	10054·15	·099463	32·986	·030316	3323456·	15075000·	50

The resistances in the above Table are calculated from **Dr. Matthiessen's standard** (1 mile of pure copper wire of $\frac{1}{10}$in. diameter equals 13·59 ohms or B.A. units at 15·5° C.) The resistance of pure wire increases as the temperature rises about 0·38 per cent. for each degree C., and 0·21 for each degree F.

The Diameter (d) of any copper wire equals the square root of its weight (w) in grains per foot multiplied by 6·672

$$d = 6{\cdot}672\ \sqrt{w} \quad . \quad . \quad . \quad \text{mils.}$$

The Weight (w) of any copper wire per foot in grains equals the square of its diameter (mils.), divided by 47·22

$$w = \frac{d^2}{47{\cdot}22} \quad . \quad \text{grains per foot.}$$

The Resistance (R) of any pure copper wire per mile at 15·5° C. equals the square of its diameter (mils.) divided into 53087·9

$$R = \frac{53085{\cdot}9}{d^2} \quad . \quad . \quad \text{ohms at 15·5° C. per mile.}$$

The Conductivity (C) of any copper wire is obtained by multiplying its calculated resistance (R) by 100 and dividing the product by its measured resistance (r).

$$C = \frac{R \times 100}{r} \quad . \quad . \quad . \quad . \quad \text{conductivity per cent.}$$

* It will be noticed that several of the figures in the decimal places differ slightly from figures given in other tables, but some of these differences may be accounted for by the difference of temperature at which the measurements were taken.

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ELECTRIC LIGHT AND POWER CONDUCTORS.

(Inserted with the permission of the Compiler, Mr. E. W. BECKINGSALE.)

This Table is prepared for use with covered wires.

The Current column is on the basis of 1,000 amperes per square inch sectional area of the conductor.

From the column of reciprocals the *combined resistance* of any strand or circuits of different sizes can readily be found by adding the reciprocals of the respective resistances, and looking for the corresponding number in reciprocal column; when in the ohms column, exactly opposite will be found the approximate resistance required.

The coefficients under the constant, $C^2/746$, multiplied by the resistances, give the horse-power lost per 1,000 feet of conductor.

Board of Trade New Legal Standard Wire Gauge.		Exact Diameter.	Exact Sect. Area.	Weights, 1,000 Feet.		Resistance, 1,000 Feet.		Current.	$C^2/746$
Nearest Nos.	Diameter Ins.	Inches.	Square Inches.	lbs.	Tons.	Ohms.	Reciprocals.	Amperes	
		1·1284	1·00	3854·2	1·7206	·00853	117·23	1000	1340·5
		1·0705	·90	3468·7	1·5485	·00948	105·52	900	1085·8
		1·0093	·80	3083·3	1·3765	·01066	93·789	800	857·91
		·94407	·70	2698·0	1·2044	·01218	82·065	700	656·84
		·90972	·65	2505·2	1·1184	·01312	76·203	650	566·35
		·87404	·60	2312·5	1·0324	·01422	70·341	600	482·57
		·83682	·55	2119·8	94633	·01551	64·479	550	405·49
		·79787	·50	1927·1	·86030	·01706	58·617	500	335·12
		·77768	·475	1830·7	·81728	·01796	55·687	475	302·44
		·75694	·450	1734·4	·77427	·01896	52·756	450	271·44
		·73562	·425	1638 0	·73126	·02007	49·825	425	242·13
		·71365	·400	1541·7	·68824	·02133	46·895	400	214·48
		·69099	·375	1445·3	·64522	·02275	43·963	375	188·51
		·66756	·350	1349·0	·60221	·02437	41·033	350	164·21
		·64328	·325	1252·6	·55919	·02625	38·102	325	141·59
		·61803	·300	1156·2	·51618	·02843	35·171	300	120·64
		·59173	·275	1059·9	·47316	·03102	32·240	275	101·37
		·56417	·250	963·54	·43015	·03412	29·308	250	83·780
		·53524	·225	867·18	·38713	·03791	26·378	225	67·861
7/0	·500	·50463	·200	770·80	·34412	·04265	23·447	200	55·619
6/0	·464	·47204	·175	674·48	·30111	·04874	20·516	175	41·053
5/0	·432	·43706	·150	578·12	·25809	·05687	17·585	150	30·161
4/0	·400	·39894	·125	481·77	·21508	·06824	14·654	125	20·945
3/0	·372	·35682	·100	385·42	·17206	·08530	11·723	100	13·405
2/0	·348	·33851	·090	346·87	·15485	·09478	10·552	90	10·858
0	·324	·31916	·080	308·33	·13765	·10662	9·3789	80	8·5791
1	·300	·29854	·070	269·80	·12044	·12185	8·2065	70	6·5684
1	·300	·28768	·065	250·52	·11184	·13123	7·6203	65	5·6634
2	·276	·27640	·060	231·25	·10324	·14217	7·0341	60	4·8257
3	·252	·26462	·055	211·98	·09463	·15509	6·4479	55	4·0549
3	·252	·25232	·050	192·71	·08603	·17060	5·8617	50	3·3512
3	·252	·24592	·0475	183·07	·08173	·17958	5·5687	47·5	3·0244
3	·252	·23937	·0450	173·44	·07743	·18955	5·2756	45	2·7144
4	·232	·23262	·0425	163·80	·07313	·20070	4·9825	42·5	2·4123
4	·232	·22567	·0400	154·17	·06882	·21325	4·6895	40	2·1448

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ELECTRIC LIGHT AND POWER CONDUCTORS—(*continued*).

Board of Trade New Legal Standard Wire Gauge.	Exact Diameter.	Exact Sect. Area.	Weights, 1,000 Feet.		Resistance, 1,000 Feet.		Current.	$C^2/746$
Nearest Nos.	Diameter Ins.	Inches.	Square Inches.	lbs.	Tons.	Ohms.	Reciprocals.	Amperes
5	·212	·21851	·0375	144·53	·06452	·22746	4·3963	37·5	1·8851
5	·212	·21110	·0350	134·90	·06022	·24371	4·1033	35	1·6421
5	·212	·20342	·0325	125·26	·05592	·26246	3·8102	32·5	1·4159
6	·192	·19544	·0300	115·62	·05162	·28433	3·5171	30	1·2064
6	·192	·18712	·0275	105·99	·04732	·31018	3·2240	27·5	1·0137
7	·176	·17841	·0250	96·354	·04302	·34120	2·9308	25	·83780
7	·176	·16925	·0225	86·718	·03871	·37911	2·6378	22·5	·67861
8	·160	·15958	·0200	77·080	·03441	·42649	2·3447	20	·53619
9	·144	·14927	·0175	67·448	·03011	·48742	2·0516	17·5	·41053
9	·144	·13819	·0150	57·812	·02581	·56866	1·7585	15	·30161
10	·128	·12616	·0125	48·177	·02151	·68239	1·4654	12·5	·20945
11	·116	·11284	·0100	38·542	·01721	·85299	1·1723	10	·13405
12	·104	·10705	·0090	34·687	·01549	·94776	1·0552	9	·10858
12	·104	·10093	·0080	30·833	·01376	1·0662	·93789	8	·08579
13	·092	·09441	·0070	26·980	·01204	1·2185	·82065	7	·06568
13	·092	·08740	·0060	23·125	·01032	1·4217	·70341	6	·04825
14	·080	·07979	·0050	19·271	·00860	1·7060	·58617	5	·03351
15	·072	·07569	·0045	17·344	·00774	1·8955	·52756	4·5	·02714
15	·072	·07137	·0040	15·417	·00688	2·1325	·46895	4	·02145
16	·064	·06676	·0035	13·490	·00602	2·4371	·41033	3·5	·01642
16	·064	·06180	·0030	11·562	·00516	2·8433	·35171	3	·01206
17	·056	·05642	·0025	9·6354	·00430	3·4119	·29308	2·5	·00838
18	·048	·05046	·0020	7·7084	·00344	4·2649	·23447	2	·00536
19	·040	·04371	·0015	5·7812	·00258	5·6866	·17585	1·5	·00302
20	·036	·03568	·0010	3·8542	·00172	8·5299	·11723	1	·00134
21	·032	·03385	·0009	3·4687	·00155	9·4776	·10552	·9	·00109
21	·032	·03192	·0008	3·0833	·00138	10·662	·09379	·8	·00086

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VIRTUAL RESISTANCE, &c., OF CONDUCTORS WITH ALTERNATE CURRENTS.—(MORDEY.)

The following Table shews the limits of diameter of solid or stranded conductors at which the virtual resistance effect becomes objectionable. It gives also the current that may be carried by the safe diameters, and the corresponding watts at 2,000 and 100 volts.

Diameter of copper.		Area of cross-section.		Increase over ordinary resistance.	Current at 450 amperes per sq. in.	Watts at 2,000 volts.	Watts at 100 volts.	∼ per second.
mm.	Inch.	Sq. mm.	Sq. in.					
10	0·3937	78·54	0·12	Less than $\frac{1}{100}$ p.c.	55 0	110,000	5,500	80
15	0·5907	176·7	0·274	$2\frac{1}{2}$ p.c.	133·0	266,000	13,300	
20	0·7874	314·16	0·487	8 p.c.	220·0	444,000	22,000	
25	0·9842	490·8	0·760	$17\frac{1}{2}$ p.c.	...	...	...	
40	1·575	1,256	1·95	68 p.c.	...	...	...	
100	3·937	7,854	12·17	3·8 times	...	...	...	
1,000	39·37	785,400	1,217	35 times	...	...	...	
9	0·3543	63·62	0·098	Less than $\frac{1}{100}$ p.c.	45·0	90,000	4,500	100
13·4	0·5280	141·3	0·218	$2\frac{1}{2}$ p.c.	98·5	197,000	9,850	
18	0·7086	254·4	0·394	8 p.c.	178·0	356,000	17,800	
22·4	0 8826	394·0	0·611	$17\frac{1}{2}$ p.c.	...	...	...	
7·75	0·3013	47·2	0·071	Less than $\frac{1}{100}$ p.c.	32·0	64,000	3,200	133
11·61	0·4570	106·0	0·164	$2\frac{1}{2}$ p.c.	74·0	148,000	7,400	
15·5	0·6102	189·0	0·292	8 p.c.	131·4	263,000	13,140	
19·36	0·7622	294·0	0·456	$17\frac{1}{2}$ p.c.	...	...	...	

Data for copper conductors working with 2,000 volts pressure at the primary terminals of the transformers.

The following particulars refer to conductors for primary circuits working at 2,000 volts, and show the sizes for various numbers of lamps giving a loss of 1 per cent. per mile run.

Transformers taken at 95 per cent. efficiency.

To allow 1 per cent. loss of pressure per mile of conductor, the primary current density should be 450 amperes per square inch. This density also gives 1·15 per cent. loss per 100 yards, for 100 volt circuits.

PRIMARY CONDUCTORS FOR ANY GIVEN NUMBER OF 60-WATT LAMPS ON SECONDARY.

Sectional area, in square inches = number of lamps × 0·00007.
Weight per mile in lbs. = ,, ,, × 1·44.
Resistance per mile, in ohms = 630 ÷ number of lamps.

The following conductors comply with the above rule, and none of them is affected by the virtual resistance effect :—

Number of lamps.	B.W.G. No.	Diameter.	Sectional area.	Weight per mile.	Resistance per mile.
		Inch.	Square inch.	lbs.	Ohms.
100	13	0·098	0·007088	144	6·3658
200	10	0·134	0·014102	286	3·1890
300	8	0·165	0·02138	433	2·1102
400	$6\frac{1}{2}$	0·191	0·02865	578	1·5747
1,000	1	0·300	0·07065	1,433	0 6401

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GENERAL TABLE OF REFERENCE FOR STRANDED CABLES.

By Permission of the India Rubber, Gutta Percha, and Telegraph Works Company, Limited.

PARTICULARS OF CONDUCTORS.

Number of Wires in Strand.	Legal standard Gauge of each Wire.	Diameter. Of each Single Wire		Diameter. Of the Strand.		Equivalent to Solid Wires. Diameter.		Equivalent to Solid Wires. Area.		Weight of Conductor. Per Statute Mile.	Weight of Conductor. Per Kilometre.	Resistance at 60° Fahr. Per Statute Mile.	Resistance at 60° Fahr. Per Kilometre
		Inches.	m/m.	Inches	m/m.	Inches.	m/m.	Square Inches	Square m/m.	lbs.	Kilogrs.	Ohms.	Ohms.
3	25	·020	·508	·042	1·07	·034	·863	·0009	0·585	19	6	46·79	29·07
3	23	·024	·609	·051	1·29	·042	1·06	·0014	0·893	28	8	32·50	20·19
3	22	·028	·711	·059	1·50	·049	1·24	·0019	1·216	38	11	23·87	14·83
7	25	·020	·508	·060	1·54	·053	1·35	·0022	1·423	45	13	20·01	12·43
7	23	·024	·609	·072	1·83	·064	1·62	·0032	2·075	65	19	13·89	8·630
7	22	·028	·711	·084	2·13	·075	1·90	·0044	2·849	89	25	10·20	6·337
7	21½	·030	·762	·090	2·28	·080	2·03	·0050	3·242	102	29	8·893	5·525
7	21	—	—	—	—	·084	—	·0056	—	—	—	—	—
7	20½	·033	·838	099	2·51	·088	2·23	·0061	3·923	124	35	7·342	4·561
7	20	·036	·914	·108	2·74	·096	2·43	·0072	4·65	147	42	6·175	3·835
7	19	·040	1·02	·120	3·04	·107	2·71	·0089	5·77	182	52	5·002	3·108
7	18	·048	1·22	·144	3·66	·128	3·25	·0128	8·30	262	74	3·473	2·158
7	17	·056	1·42	·168	4·27	·149	3·78	·0174	11·28	356	100	2·552	1·585
7	16	·064	1·63	·192	4·88	·171	4·34	·0229	14·73	465	132	1·953	1·213
7	15	·072	1·83	·216	5·49	·192	4·87	·0289	18·66	589	166	1·543	·9589
7	14	·080	2·03	·240	6·10	·213	5·41	·0356	22·98	727	205	1·253	·7785
7	13	—	—	—	—	·243	—	·0465	—	—	—	—	—
19	21	—	—	—	—	.395	—	·0153	—	—	—	—	—
19	20	·036	·914	·180	4·57	·159	4·03	·0198	12·74	402	113	2·261	1·404
19	19	·040	1·02	·200	5·08	·176	4·47	·0243	15·72	496	140	1·831	1·137
19	18	·048	1·22	·240	6·10	·211	5·35	·0349	22·66	715	201	1·271	·7897
19	17	·056	1·42	·280	7·10	·247	6·27	·0479	30·91	973	274	·9300	·5790
19	16	·064	1·63	·320	8·12	·282	7·16	·0624	40·25	1,270	358	·7154	·4445
19	15	·072	1·83	·360	9·14	·317	8·05	·0789	50·96	1,608	453	·5652	·3512
19	14	·080	2·03	·400	10·1	·352	8·94	·0973	62·77	1,985	559	·4579	·2845
19	13	·092	2·34	·460	11·6	·404	10·7	·1282	83·20	2,625	740	·3462	·2151
19	12	·104	2·64	·520	13·2	·458	11·6	·1647	106·3	3,354	945	·2709	·1683
37	16	·064	1·63	·448	11·3	·394	10·0	·1219	78·6	2,482	699	·3661	·2274
37	15	·072	1·83	·504	12·8	·443	11·2	·1541	99·58	3,142	885	·2892	·1797
37	14	·080	2·03	·560	14·2	·493	12·5	·1909	122·9	3,879	1,093	·2343	·1456
37	13	·092	2·34	·644	16·3	·566	14·3	·2516	162·6	5,130	1,445	·1772	·1101
37	12	·104	2·64	·728	18·4	·640	16·2	·3217	207·7	6,555	1,847	·1386	·0861
61	13	·092	2·34	·828	21·0	·728	18·5	·4162	268·7	8,477	2,389	·1072	·0666
61	12	·104	2·64	·936	23·7	·823	20·9	·5319	343·4	10,832	3,052	·0839	·0521

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TABLE giving the Relation between the Resistance and together with the Amount of Current which

B. W. G.	Single Wire. Diameter.	Area.	(a).—Resist. in ohms. Per mile.	Per 100 yards.	(b).—Weight in lbs. Per mile	Per 100 yards.	(c). Ab. safe-wrkng cur.	Seven Area.	Resist. in ohms. Per mile.	Per 100 yards.
	1·00	·7854	·05737	·00326	15924	904·78	1494			
	·75	·44178	·10208	·00580	8957	508·93				
	·707	·39258	·11492	·00653	7958	452·16	732			
	·500	·19635	·2300	·01307	3986	226·10	373			
	·354	·09842	·45848	·02605	1995	113·37	187			
0	·340	·09079	·49702	·02824	1841	104·6	172			
1	·300	·07068	·64011	·03637	1433	81·42	134	·4947	·0914	·00519
2	·284	·06334	·7124	·04048	1284	73·00	120	·4433	·1017	·00578
3	·259	·05268	·8566	·04867	1208	68·68	100	·3687	·1223	·00695
4	·238	·04448	1·0144	·05764	908	51·61	85	·3113	·1447	·00820
5	·220	·03801	1·1862	·06740	776	43·78	72	·2660	·1694	·00962
5½	·211	·03496	1·2906	·07333	768	40·27	66		·1843	
6	·203	·03236	1·3969	·07937	656	37·27	61	·2265	·1775	·01134
6½	·191	·02865	1·4318	·08949	575	32·68	54			
7	·180	·02544	1·7705	·1006	515	29·3	48	·1781	·2529	·01437
7½	·172	·02324	1·9412	·1103	470	26·75	44			
8	·165	·02138	2·1102	·1199	433	24·62	40	·1496	·3014	·01712
8½	·156	·01911	2·3601	·1341	387	22·00	36			
9	·148	·01720	2·6258	·1492	348	19·81	32	·12042	·3751	·02131
9½	·141	015614	2·8898	·1642	316	17·98	29			
10	·134	·014102	3·1890	·1812	286	16·25	26	·09871	·4555	·02588
10½	·127	·012667	3·5622	·2024	256	14·56	24			
11	·120	·011309	3·9898	·2267	228	13·00	21	·07916	·5675	·0324
11½	·114	·010207	4·4210	·2512	206	11·75	19			
12	·109	·009331	4·8364	·2748	189	10·74	17	·06531	·6909	·0392
12½	·102	·008091	5·5246	·3139	164	9·31	15			
13	·095	·007088	6·3658	·3617	144	8·16	13	·04961	·9094	·05167
13½	·089	·006221	7·2512	·4120	123	7·16	11			
14	·083	·005410	8·3406	·4739	110	6·23	10	·03787	1·1915	·0677
14½	·077	·004656	9·6905	·5506	94·23	5·36	8			
15	·072	·004071	11·0844	·6298	82·36	4·68	7	·02849	1·5832	·0899
15½	·068	·003631	12·4256	·7060	73·56	4·18	7			
16	·065	·0033183	13·6994	·7727	67·22	3·82	6	·02322	1·9570	·1104
17	·058	·002642	17·0912	·9711	53·50	3·04	5	·01849	2·4430	·1387
18	·049	·001885	23·932	1·3598	36·42	2·07	3	·01420	3·419	·1942
19	·042	·0013854	32·563	1·8502	28·16	1·60	2	·00969	4·651	·2644
20	·035	·0009621	46·904	2·665	19·50	1·108	1	·006734	6·709	·3807
21	·032	·0008042		3·188		·926	1	·005628		·4554
22	·028	·0006157		4·164		·709	1	·004305		·5949
23	·025	·0004908		5·224		·565		·003436		·732
24	·022	·0003801		6·745		·437				
25	·020	·0003141		8·162		·361				
26	·018	·0002544		10·061		·292				
27	·016	·000201		12·750		·231				
28	·014	·0001539		16·65		·177				
29	·013	·0001327		19·32		·152				
30	·012	·0001130		22·67		·127				

(a) 95 per cent. conductivity $R = \frac{1003265}{d^2}$ (b) 1 cubic inch

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Weight of Electric Lighting Leads of various diameters, can be safely carried thereby, and other Data.

Strands.			Nineteen Strands.					
Weight in lbs.		Absolute safe-working cur.	Area.	Resist. in ohms.		Weight in lbs.		Absolute safe-working cur.
Per mile.	Per 100 yards.			Per mile.	Per 100 yards.	Per mile.	Per Min.	
10031	567·94	946	1·34292	·03361	·00191	27227	1547	2553
8988	511·00	843	1·20359	·03748	·00213	24411	1387	2289
8456	424·76	701	1·001053	·04505	·00256	20293	1153	1904
6356	361·27	595	·845272	·05332	·00303	17248	980	1614
5390	306·46	506	·722247	·06230	·00354	14643	832	1375
4592	260·89	430	·61493	·07339	·00417	12460	708	1169
3605	205·1	338	·48336	·09328	·0053	9803	557	919
3031	172·34	284	·406258	·11086	·0063	8236	468	773
2436	138·67	228	·326857	·13816	·00785	6617	376	621
2002	113·75	188	·26793	·16772	·00953	5438	309	510
1596	91·00	150	·214871	·20996	·01193	4347	247	409
1323	75·18	124	·177289	·25448	·01446	3590	204	337
1008	57·12	94	·134672	·33492	·01903	2728	155	259
770	43·61	72	·102790	·43824	·02490	2076	118	195
659								
576	32·76	54	·077349	·58256	·03310	1566	89	147
470	26·74	44	·063047	·71560	·04066	1276	72·5	119
374	21·30	35	·050198	·89936	·05110	1019	57·81	96
255	14·50	24	·035828	1·2594	·07156	692	39·36	66
197	11·19	20	·026322	1·7144	·09741	531	30·21	49
136	7·75	12	·018279	2·4685	·14026	369	21·00	34
	6·48	10	·015279	2·9534	·16781	306	17·4	28
	4·96	8	·011698	3·8576	·21918	237	13·5	22
	3·96	6	·009325	4·8400	·2750	199	10·75	17

of copper = 0·32 lb. (c) $C^3 = \frac{W}{R} \times 8·05$.

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COPPER WIRE GAUGES.

DIAMETERS IN DECIMALS OF AN INCH.

Number of Wire Gauge.	Standard.	Birmingham.	Brown and Sharpe. (American.)	National Electric Light Association.
000000	·464	—	—	—
00000	·432	—	—	—
0000	·4	·454	·46	—
000	·372	·425	·40964	—
00	·348	·380	·3648	—
0	·324	·340	·32495	—
1	·3	·3	·2893	·0039
2	·276	·284	·25763	·0079
3	·252	·259	·22942	·0118
4	·232	·238	·20431	·0157
5	·212	·22	·18194	·0197
6	·192	·203	·16202	·0236
7	·176	·18	·14428	·0276
8	·16	·165	·12849	·0315
9	·144	·148	·11443	·0354
10	·128	·134	·10189	·0394
11	·116	·12	·09074	·0433
12	·104	·109	·08081	·0472
13	·092	·095	·07196	·0512
14	·08	·083	·06408	·0551
15	·072	·072	·05706	·0591
16	·064	·065	·05082	·0630
17	·056	·058	·04525	·0669
18	·048	·049	·0403	·0709
19	·04	·042	·03589	·0748
20	·036	·035	·03196	·0787
21	·032	·032	·02846	·0827
22	·028	·028	·02534	·0866
23	·024	·025	·02257	·0906
24	·022	·022	·0201	·0945
25	·02	·02	·0179	·0984
26	·018	·018	·01594	·1024
27	·0164	·016	·01419	·1063
28	·0148	·014	·01264	·1102
29	·0136	·013	·01125	·1142
30	·0124	·012	·01002	·1181
31	·0116	·010	·00893	·1220
32	·0108	·009	·00795	·1260
33	·01	·008	·00708	·1299
34	·0092	·007	·0063	·1339
35	·0084	·005	·00561	·1378
36	·0076	·004	·005	·1417

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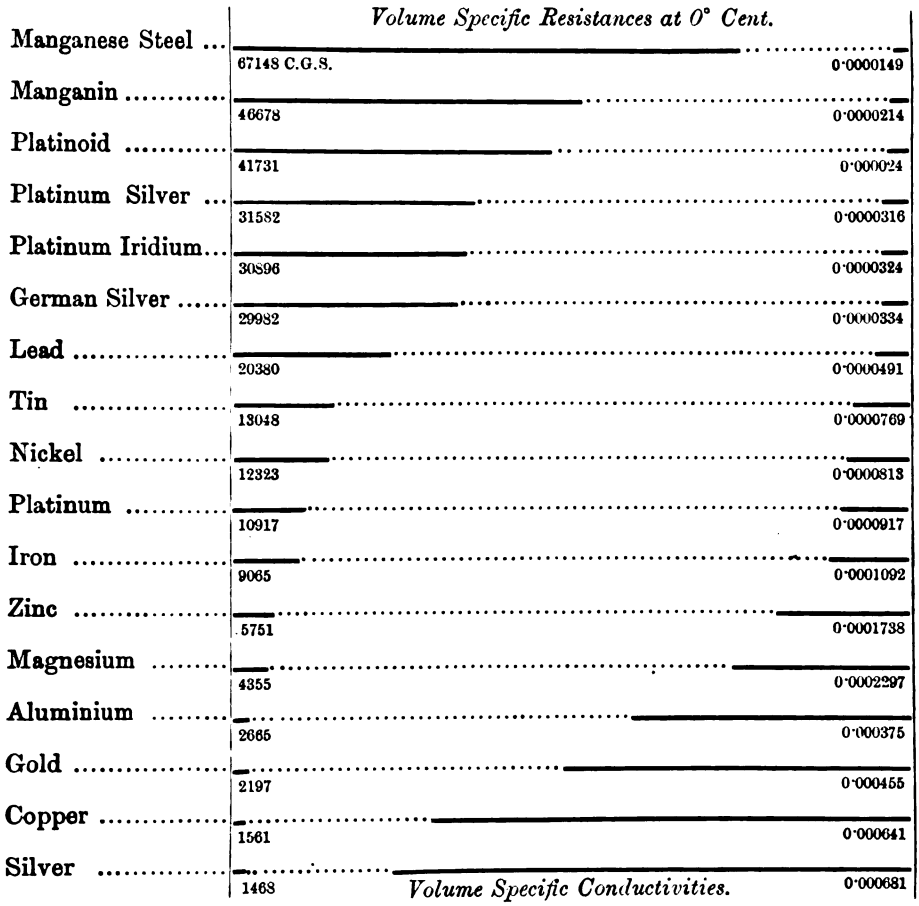
RESISTANCES AND CONDUCTIVITIES OF METALS AND ALLOYS, AT 0°C.

(Specially Prepared for "The Electrician" Electrical Trades' Directory.)



The length of the lines in this table is based upon the determinations of volume specific resistances by Profs. Dewar and Fleming. "Volume specific resistance" is defined as the resistance between opposite faces of a centimetre cube of the material in C.G.S. units. These values are marked under the lines; the value for manganese steel being 67148, and for silver 1468. If these numbers are divided by 100,000 the quotient is the resistance in *ohms* of a wire of the material one metre long and one square millimetre in section. The lengths of the resistance lines of these two metals in the diagram are 67·1 millimetres and 1·5 millimetres respectively. The lengths of the lines representing "volume specific conductivities" are the reciprocals of the corresponding resistances. Wires of different metals, all of the same diameter, and of lengths equal to or multiples of the lengths of these conductivity lines, will all be of the same resistance. With wires of different metals, all of the same length and of the same resistance, the sectional areas must be proportional to the length of the resistance lines.

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SPECIFIC RESISTANCE TABLE.

Metals, Alloys, Electrolytes, Insulators.

(*Compiled from various sources.*)

METALS AND ALLOYS.

METAL OR ALLOY.	Resistance compared with copper (*approx.*)	Specific resistance in C.G.S. units at 0°C.	Temperature coefficient per 1°C.
Aluminium (annealed)	2	2,946	0·0039
Aluminium (hard-drawn)	2	3,160	0·0039
Antimony (pressed)	22½	35,900	0·0039
Bismuth (pressed)	83	132,650	0·0054
Cadmium	6¼	6,800	.....
Carbon (retort)	42,000	67×10^6	.....
Carbon (arc light. *Carré*)	4,400	7×10^6	−0·0005
Carbon (glow lamp. *Edison-Swan*)	2,500	4×10^6	−0·00054
Copper (soft)	1	1,580	0·00388
Copper (hard)	1	1,616	0·00388
German silver (Cu 4 parts, Ni 2 „, Zn 1 „)	13¼	21,170	0·00044
Gold (purest soft)	1⅓	1,952	0·00336
Gold (hard-drawn)	1⅓	2,118	0·00365
Iron	6	9,611	0·0048
Lead (pressed)	12¼	19,850	0·00387
Lead peroxide (chem. prepared)	4×10^6	5590×10^6	.....*
Lead peroxide (electrolytically „)	4×10^6	6780×10^6	.....*
Mercury (liquid)	59	94,070	0·00072
Manganin (Cu 84 per cent., Mn 12 „, Ni 4 „)	26	42,000	0° to 10°C. = +0·000025 10° to 20°C. = +0·000014 20° to 30°C. = +0·000003 30° to 40°C. = 0 40° to 50°C. = −0·000003 50° to 60°C. = −0·000006
Manganese copper (Cu 70 per cent., Mn 30 „)	63	100,600	0·00004
Nickel (pure)	7¾	12,290	0·0048
Platinum (pure annealed)	5	8,222	0·0032
Platinoid (German silver + 1 or 2 per cent. of Tungsten)	27¼	43,600	0·00025
Platinum iridium (Pt = 80 per cent., Ir = 20 „)	18⅓	29,375	0·00089
Platinum silver (Pt = 33 „, Ag = 66 „)	16¾	26,820	0·00018
Phosphor bronze (commercial)	5⅛	8,479	0·00064
Silver (annealed)	...	1,521	0·00377
Silver (hard-drawn)	...	1,652	.....
Tin (pure)	6	9,565	0·004
Tin (pressed)	8⅓	13,360	0·0036
Zinc (pressed)	3½	5,690	0·0036

* John Shields, *Chem. News*: "No alteration observed on heating up to 115°C."

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ELECTROLYTES.

Electrolyte.	Specific Resistance at the average temperature of 15° to 20°C. in C.G.S. units per cubic centimetre.
Water (ordinary distilled)	$72{,}000 \times 10^6$
Bichromate of Potash (saturated solution)	$70{,}000 \times 10^6$
„ „ (diluted with 10 p. c. sulphuric acid)	$7{,}000 \times 10^6$
Bichromate of Soda (saturated solution)	$22{,}000 \times 10^6$
„ „ (diluted with 50 p. c. sulphuric acid)	$8{,}500 \times 10^6$
Chromic Acid (44 per cent. acid + 56 per cent. water)	$4{,}800 \times 10^6$
„ „ (44 „ acid + 56 p. c. sulphuric acid)	$5{,}800 \times 10^6$
Common Salt (saturated solution)	$5{,}000 \times 10^6$
Nitric Acid (Δ 1·36)	$1{,}400 \times 10^6$
Sal-ammoniac (Δ 1·07)	$2{,}500 \times 10^6$
Sulphuric Acid (10 per cent. acid Δ 1·07)	850×10^6
„ „ (25 „ acid Δ 1·17)	$1{,}000 \times 10^6$
„ „ (75 „ acid Δ 1·7)	$4{,}250 \times 10^6$
Sulphate of Copper (saturated solution)	$25{,}000 \times 10^6$
„ „ (diluted with 25 p. c. sulphuric acid)	$19{,}500 \times 10^6$
Sulphate of Zinc (saturated solution)	$21{,}000 \times 10^6$

NOTE.—The Specific Resistance of Electrolytes *falls* rapidly as the temperature rises. The temperature coefficients range from 0·5% to 2% per degree centigrade.

INSULATORS.

Insulator.	Specific Resistance in *Preece* units (*Megohms per cubic quadrant*).	Specific Resistance compared with Mica.	Temperature.
Mica	0·084	1	20°C.
COMPOUNDS—			
Callender (Electric Light Cable)	0·45	$5\frac{1}{3}$	15°C.
Fowler-Waring („ „)	7·33	86	15°C.
Hooper (Submarine Cable)	15·00	178	24°C.
Siemens (Fibre)	11·90	141	15°C.
Ebonite	28·00	333	46°C.
Glass (ordinary)	0·09	1	20°C.
„ (flint)	20·00	238	20°C.
Gutta-Percha	0·45	$5\frac{1}{3}$	24°C.
India-Rubber (Untreated)	10·90	130	24°C.
„ „ (Siemens' Special)	16·20	200	15°C.
„ „ (Vulcanised)	1·50	18	15°C.
„ „ (Ozokerited)	6·60	77	15°C.
Paper (Ordinary)	3×10^{-6}	—	—
„ (Cardboard)	5×10^{-6}	—	—
„ (Parchment)	30×10^{-6}	—	—
Paraffin	34·00	405	46°C.
Shellac	9·00	107	28°C.

NOTES.—(i.) The Specific Resistance of Insulators *decreases* as the temperature rises (ii.) 1 Preece Unit = 10^{24} C.G.S. units = 10^{15} ohms per cub. cm. = 10^9 megohms per cub. cm.

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TABLE OF ELECTRO-CHEMICAL EQUIVALENTS, &c.

Calculated on the basis of Lord Rayleigh's recent determination of the electro-chemical equivalent of Silver, and the corrected atomic weights of the elements as given by Roscoe.

Elements.	Valency.	Atomic Weight.	Chemical Equivalent.	Electro-Chemical Equivalent (Milligrammes per Coulomb).	Coulombs per Gramme.	Grammes per Ampere Hour.	Log.	Log.
			e	*s*	*q*	*w*	*q*	*w*
Electro-Positive.								
Hydrogen	H^1	1·	1·	·010384	96293·00	0·03738	4·9836353	$\bar{2}$·5727090
Potassium	K^1	39·04	39·04	·40539	2467·50	1·45950	3·3922572	0·1642041
Sodium	Na^1	22·99	22·99	·23873	4188·90	0·85942	3·6221000	$\bar{1}$·9342055
Aluminum.....	Al^3	27·3	9·1	·09449	1058·30	3·40180	3·0245939	0·5317086
Magnesium	Mg^2	23·94	11·97	·12430	804·03	4·47470	2·9055411	0·6507614
Gold	Au^3	196·2	65·4	·67911	1473·50	2·44480	3·1683501	0·3882433
Silver.....	Ag^1	107·66	107·66	1·11800	894·41	4·02500	2·9515366	0·6047659
Copper (Cupric) ...	Cu^2	63·	31·5	·32709	3058·60	1·17700	3·4855227	0·0707765
" (Cuprous)...	Cu^1	63·	63·	·65419	1525·30	2·35500	3·1833553	0·3719909
Mercury (Mercuric)	Hg^1	199·8	99·9	1·03740	963·99	3·73450	2·9840725	0·5722325
" (Mercurous)	Hg^1	199·8	199·8	2·07470	481·99	7·46900	2·6830380	0·8732625
Tin (Stannic).....	Sn^4	117·8	29·45	·30581	3270·00	1·10090	3·5145478	0·0417479
" (Stannous)	Sn^2	117·8	58·9	·61162	1635·00	2·20180	3·2135178	0·3427779
Iron (Ferric).....	Fe^4	55·9	18·64*	·19356	5166·4	·69681	3·7131894	$\bar{1}$·8431131
" (Ferrous)	Fe^2	55·9	27·95	·29035	3445·50	1·04480	3·5372523	0·0190332
Nickel	Ni^2	58·6	29·3	·30425	3286·80	1·09530	3·5167733	0·0395331
Zinc	Zn^2	64·9	32·45	·33696	2967·10	1·21330	3·4723322	0·0839682
Lead	Pb^2	206·4	103·2	1·07160	933·26	3·85780	2·9700027	0·5863397
Electro-Negative.								
Oxygen	O^2	15·96	7·98	·08286				
Chlorine.....	Cl^1	35·37	35·37	·36728				
Iodine	I^1	126·53	126·53	1·31390				
Bromine.....	Br^1	79·75	79·75	·82812				
Nitrogen	N^3	14·01	4·67	·04849				

* Becquerel's extension of Faraday's law showed that the electro-chemical equivalent of an element is proportional to its chemical equivalent. The latter is equal to its combining weight, and not to atomic weight ÷ valency, as defined by Thompson, Hospitalier and others who have copied their tables. For example, the ferric salt is an exception to Thompson's rule, as are sesqui salts in general.

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NOTES ON ILLUMINATION.

For indoor use, the illumination produced by a standard candle at a distance of 1 foot is suitable for most ordinary purposes. Mr. Preece's rule is :—One 16-candle lamp, 8 feet high, for every 8 feet square, or 64 square feet. The colour of the ceiling and walls so greatly affects the illumination that definite rules are of doubtful value. The reflection from walls and ceilings of a fairly light colour will double the illumination by reflection. Mr. Preece's rule works out to 1 watt per square foot ; the colour of the walls may allow this to be reduced to half a watt, or may necessitate an increase to more than 2 watts per square foot.

Arc lamps 18 feet above the ground, taking 10 amperes, give a maximum illumination of about half a candle at 1 foot distance. Such lamps, arranged 120 feet apart, give a minimum illumination equal to about ·03 candle at 1 foot. This is considered good for street lighting.

One candle at 1 foot is equivalent to four candles at 2 feet, or to nine candles at 3 feet, &c.; but to say off-hand what illumination would be produced by a 16-candle lamp at a distance of 8 feet is rather puzzling at first. In terms of the unit produced by one candle at 1 foot, the illumination would be $16/8^2 = \frac{1}{4}$.

The following table will be found convenient, each of the combinations being approximately equivalent to one candle at 1 foot :—

Candle-power.	Ft.	in.	Candle-power.	Ft.	in.
1	1	0	64	8	0
4	2	0	100	10	0
8	2	10	144	12	0
9	3	2	200	14	2
16	4	0	400	20	0
20	4	6	600	24	6
30	5	6	1000	31	8
50	7	1	1600	40	0

The illumination at any point produced by a light radiating uniformly in all directions may be found as follows:—Let A B be the height of the lamp from the ground, A C the distance of the given point from the foot of the lamp-post, and *c.p.* the candle-power of the lamp :

$$i = \frac{A\,B \times c.p.}{A\,C^2}$$

where i is the illumination in units of one candle at 1 foot.

In order to adjust the height of A B so that the illumination at C may be a maximum, A C should be equal to A B $\times \sqrt{2}$.

When a number of lamps of given candle-power, and radiating light uniformly in all directions, are arranged in a row, as in street lighting, the row being either straight or obtusely zig-zag, the resultant illumination will depend on their height and on their distance apart. In the following table the height of the lamps is taken as 1, and the distance is measured in terms of the height. The maximum at the foot of each lamp, and the minimum illumination midway between two lamps is given in terms of the maximum. The variation between the maximum and minimum is given as a percentage of the maximum.

Distance.	Maximum.	Minimum.	Variation.	Distance.	Maximum.	Minimum.	Variation.
1	1·98	1·93	2·25%	3	1·07	·36	64·0%
2	1·22	·78	36·0%	6	1·01	·063	93·7%

Diffused Reflection and Transmission of Light.—The following reflection, transmission, and absorption of various substances are taken from a Paper read by Dr. Sumpner before the Physical Society :—

	Reflection per cent.	Transmission per cent.	Absorption per cent.		Reflection per cent.	Transmission per cent.	Absorption per cent.
White blotting paper	82	9·2	13·8	Yellow wall paper	40	—	—
White cartridge paper	80	11·2	12·2	Dirty deal	20	—	—
Tracing cloth	35	54·4	15·0	Thin opal glass	—	—	15
Tracing paper	22	76·0	7·0	Thick opal glass	—	—	39
Newspaper	50 to 70	—	—	Ground glass	—	—	42

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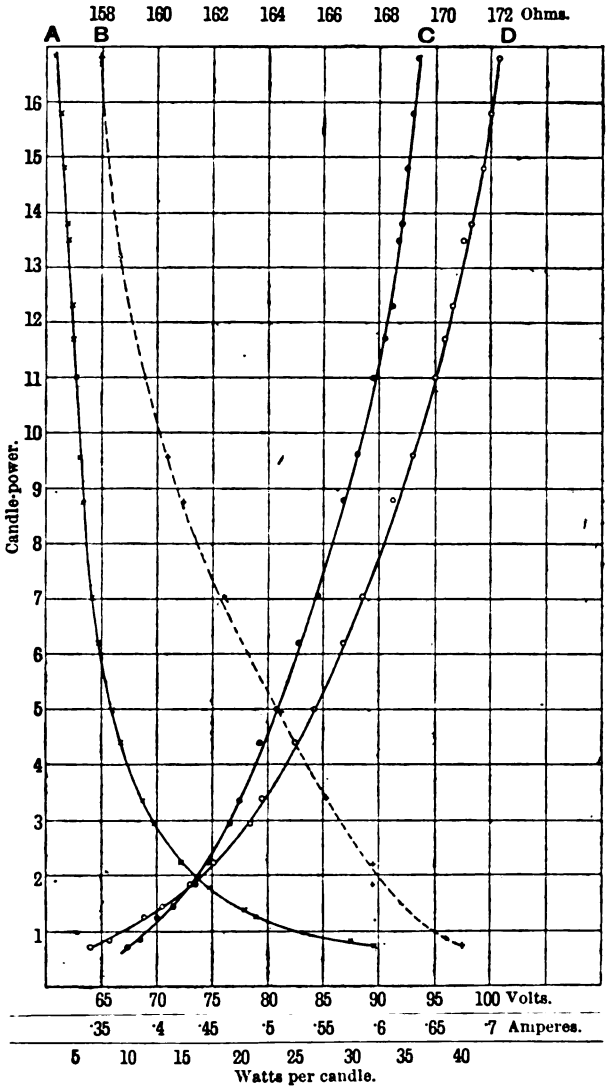
Glow Lamps.—The accompanying diagram may be taken as representing the relation of the current, volts, candle-power and watts per candle, of an average 16-c.p. 100-volt lamp of the Edison-Swan Company's make. It will be observed that a difference of one volt at about 100 volts makes a difference of about one candle-power. Or 1 per cent. difference in volts, makes a difference of 6¼ per cent. in candle-power.



Curves showing relation beween candle-power and volts, amperes, resistance, and watts per candle.

A Watts and candle-power. **C** Current.
B Resistance. **D** Volts.

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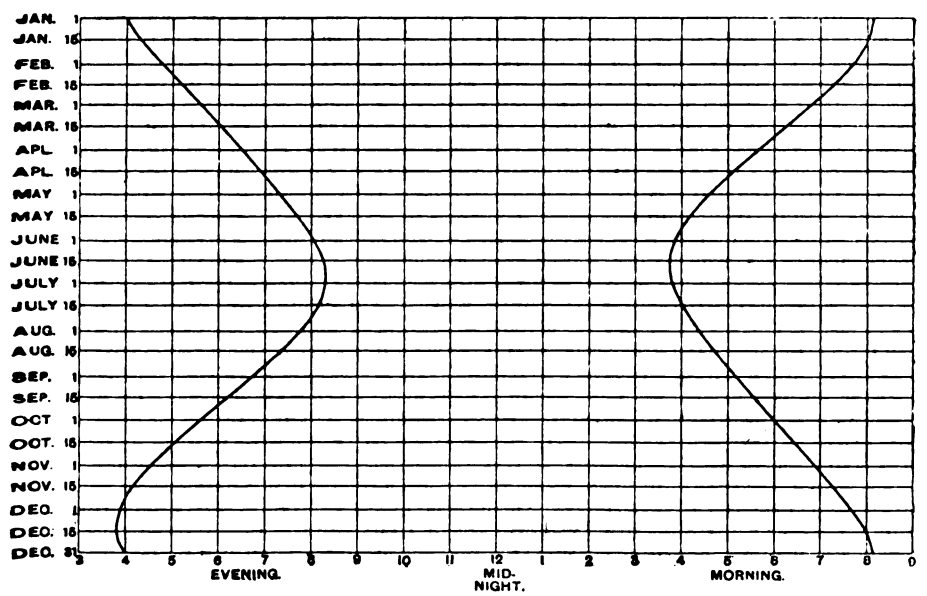
TABLE SHOWING HOURS OF LIGHTING.

Hours of lighting.	Period of the year during which light is required at these hours.	Total number of hours of lighting per annum.
6 a.m. till daylight..		250 hours
Dusk „ 5 p.m.	Oct. 1 to March 22	83 „
„ „ 6 p.m.	Sept. 21 „ „ 14	226 „
„ „ 6:30 p.m.	„ 8 „ April 1	320 „
„ „ 7 p.m.	Aug. 25 „ „ 19	430 „
„ „ 7:30 p.m.	„ 10 „ May 7	560 „
„ „ 8 p.m.	July 23 „ „ 28	730 „
„ „ 8:30 p.m.	All the Year	900 „
„ „ 9 p.m.	„ „ „	1,090 „
„ „ 10 p.m.	„ „ „	1,455 „
„ „ 11 p.m.	„ „ „	1,820 „
„ „ midnight	„ „ „	2,185 „
„ „ 2:15 a.m.	„ „ „	3,000 „
All night	„ „ „	4,380 „

These results are shown graphically in the accompanying diagram :—



The space between the curved lines represents the time during which light is required. The horizontal lines show the months of the year. The vertical lines show the hours. For further information see *The Electrician*, January 19, 1894.

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TWELVE O'CLOCK NOON GREENWICH MEAN TIME,

AS COMPARED WITH THE CLOCK IN THE FOLLOWING PLACES:—

	h.	m.					h.	m.	
Boston, United States	7	16	a.m.	Adelaide, South Australia	9	14	p.m.	Madras	5	21	p.m.
Chicago	6	10	a.m.	Auckland, New Zealand	11	39	p.m.	Malta	0	58	p.m.
Dublin	11	35	a.m.	Berlin	0	54	p.m.	Melbourne	9	40	p.m.
Edinburgh	11	47	a.m.	Berne	0	30	p.m.	Moscow	2	30	p.m.
Glasgow	11	43	a.m.	Bombay	4	51	p.m.	Paris	0	9	p.m.
Lisbon	11	23	a.m.	Brisbane, Queensland	10	12	p.m.	Pekin	7	46	p.m.
Madrid	11	45	a.m.	Brussels	0	17	p.m.	Perth, Western Australia	7	44	p.m.
Newfoundland, St. John's	8	29	a.m.	Calcutta	5	53	p.m.	Port Moresby	10	4	p.m.
New York	7	4	a.m.	Cape of Good Hope	1	14	p.m.	Prague	0	58	p.m.
Penzance	11	37	a.m.	Constantinople	1	56	p.m.	Rome	0	50	p.m.
Philadelphia	6	59	a.m.	Florence	0	45	p.m.	Rotterdam	0	18	p.m.
Quebec	7	15	a.m.	Hobart, Tasmania	9	49	p.m.	St. Petersburg	2	1	p.m.
San Francisco Port	3	52	a.m.	Jerusalem	2	21	p.m.	Stockholm	1	12	p.m.
Toronto	6	42	a.m.					Suez	2	10	p.m.
Vancouver	3	38	a.m.					Sydney, New South Wales	10	5	p.m.
								Vienna	1	6	p.m.

Variation of Time depends upon Longitude; every Degree East of Greenwich is four minutes earlier, and every Degree West four minutes later.

COMPARATIVE PRICE OF ELECTRICITY AND GAS.

Price of the Board of Trade Unit.		Price of Gas per 1,000 cubic feet.		Price of the Board of Trade Unit.		Price of Gas per 1,000 cubic feet.	
s.	d.	s.	d.	s.	d.	s.	d.
0	4	3	5	0	8	6	9
0	4½	3	10	0	8½	7	2
0	5	4	3	0	9	7	7
0	5½	4	10	0	9½	8	0
0	6	5	1	0	10	8	5
0	6½	5	6	0	10½	8	8
0	7	5	11	0	11	9	2
0	7½	6	4	1	0	10	0

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Telephone 2714.] [Telegrams: "Electrician Newspaper London."

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CONVERSION TABLE.

		Multiply by
To reduce	kilometres to miles	·62
,,	kilometres to yards	1100 (1093·6)
,,	metres to yards	1·1
,,	metres to feet	3·3
,,	centimetres to inches	·4
,,	millimetres to inches	·04
,,	millimetres to mils.	40 (39·4)
,,	miles to kilometres	1·6
,,	miles to metres	1609
,,	yards to kilometres	·0009
,,	yards to metres	·9
,,	feet to metres	·3
,,	inches to centimetres	2·54
,,	inches to millimetres	25 (25·4)
,,	mils. to millimetres	·025
,,	sq. metres to sq. yards	1·2
,,	sq. metres to sq. feet	11(10·76)
,,	sq. centimetres to sq. inches	·155
,,	sq. millimetres to sq. inches	·0015
,,	sq. yards to sq. metres	·83
,,	sq. feet to sq. metres	·09
,,	sq. inches to sq. centimetres	6·45
,,	sq. inches to sq. millimetres	645
,,	cub. metres to cub. yards	1·3
,,	cub. metres to cub. feet	35·3
,,	cub. cms. to cub. inches	·06
,,	cub. yards to cub. metres	·76
,,	cub. feet to cub. metres	·03
,,	cub. inches to cub. cms.	16·4
,,	kilogrammes to tons	·001
,,	kilogrammes to cwt.	·02
,,	kilogrammes to pounds	2·2
,,	kilogrammes to ounces	35 (35·3)
,,	grammes to ounces	·035
,,	grammes to grains	15·4
,,	milligrammes to grains	·015
,,	tons to kilogrammes	1000(1016)
,,	cwt. to kilogrammes	50 (50·8)
,,	pounds to kilogrammes	·45
,,	pounds to grammes	453 (453·6)
,,	ounces to grammes	28·35
,,	grains to grammes	·065
,,	grains to milligrammes	65 (64·8)
,,	lbs. avoir. to grains troy	7000
,,	gallons to cub. feet	·16
,,	gallons to cub. metres	·0045
,,	gallons to litres	4·5
,,	gallons of water to lbs.	10
,,	cub. feet to gallons	6·2
,,	cub. metres to gallons	220
,,	litres to gallons	·22
,,	lbs. of water to gallons	·1
,,	litres to cub. feet	·035
,,	litres of water to lbs.	2·2
,,	cub. feet to litres	28·3
,,	lbs. of water to litres	·454
,,	cub. feet of water to lbs.	62·3 (62·27)
,,	lbs. of water to cub. feet	·016
,,	feet per minute to miles per hour.	·0113
,,	feet per minute to metres per sec.	·005
,,	miles per hour to feet per minute	88
,,	metres per sec. to feet per minute	197
,,	tons per sq. foot to kilogrammes per sq. cm.	1·09
,,	tons per sq. foot to lbs. per sq. in.	15·5
,,	tons per sq. foot to head of water (feet)	36

		Multiply by
To reduce	tons per sq. foot to head of water (metres)	10·7
,,	tons per sq. foot to atmospheres	1·06
,,	lbs. per sq. inch to tons per sq. ft.	·064
,,	lbs. per sq. in. to kilogrammes per sq. cm.	·07
,,	lbs. per sq. inch to grammes per sq. cm.	70·3
,,	lbs. per sq. inch to head of water (feet)	2·3
,,	lbs. per sq. inch to head of water (metres)	·7
,,	lbs. per sq. inch to atmospheres	·07
,,	kilogrammes per sq. cm. to tons per sq. foot	·9
,,	kilogrammes per sq. cm. to lbs. per sq. inch	14·2
,,	kilogrammes per sq. mm. to lbs. per sq. inch	1422
,,	grammes per sq. cm. to lbs. per sq. in.	·014
,,	head of water (metres) to tons per sq. foot	·09
,,	head of water (feet) to tons per sq. foot	·027
,,	head of water (metres) to lbs. per sq. inch	1·4
,,	head of water (feet) to lbs. per sq. inch	·43
,,	atmospheres to tons per sq. foot	·94
,,	atmospheres to lbs. per sq. inch	14·7
,,	grains per sq. inch to dynes per sq. cm.	9·8
,,	dynes per sq. cm. to grains per sq. inch	·1
,,	carcels to candles	9·5
,,	candles to carcels	·1
,,	English candles to German	·8
,,	German candles to English	1·25
,,	joules to ergs	10^7
,,	*joules to foot lbs.	·737
,,	joules to kilogrammetres	·1
,,	joules to lbs. deg. F.	·00095
,,	joules to calories	·24
,,	calories to joules	4·2 (4·158)
,,	lbs. deg. F. to joules	1048
,,	kilogrammetres to joules	9·8
,,	foot lbs. to joules	1·35
,,	lbs. deg. F. to foot lbs.	772·
,,	lbs. deg. F. to kilogrammetres	107·
,,	lbs. deg. F. to calories	252·
,,	calories to lbs. deg. F.	·004
,,	kilogrammetres to lbs. deg. F.	·009
,,	kilogrammetres to calories	2·34
,,	kilogrammetres to foot lbs.	7·2
,,	foot lbs. to kilogrammetres	·14
,,	calories to kilogrammetres	·42
,,	H. P. to watts	746
,,	H. P. to foot lbs. per minute	33000
,,	H. P. to kilogrammetres per sec.	76
,,	watts to foot lbs. per minute	44
,,	watts to kilogrammetres per sec.	·1
,,	centimes per car-kilometre to pence per car-mile	·16
,,	pence per car-mile to centimes per car-kilometre	6·2

* One *joule* = one *watt-second*.

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METRICAL SYSTEM OF WEIGHTS AND MEASURES.

THE Metrical System is based upon the length of the fourth part of a terrestrial meridian. The ten-millionth part of this arc is called a *Metre*, and is the unit of length. The cube of the tenth part of the metre was adopted as the unit of capacity, and denominated a *Litre*. The weight of a litre of distilled water at its greatest density was called a *Kilogramme*, of which the thousandth part, or *Gramme*, was adopted as the unit of weight. The multiples of these, proceeding in decimal progression, are distinguished by the employment of the prefixes *deca*, *hecto*, *kilo*, and *myria*, and the subdivisions by *deci*, *centi*, and *milli*.

MEASURES OF LENGTH (UNIT METRE).

Equal to	Inches.	Feet.	Yards.	Miles.
Millimetre	0·039	0·003	0·001	0·000
Centimetre	0·393	0·032	0·010	0·000
Decimetre	3·937	0·328	0·109	0·000
Metre	39·370	3·280	1·093	0·000
Decametre	393·707	32·808	10·936	0·006
Hectometre	3937·079	328·089	109·363	0·062
Kilometre	39370·790	3280·899	1093·633	0·621

CUBIC, OR MEASURES OF CAPACITY (UNIT LITRE).

Equal to	Cubic inches.	Cubic feet.	Pints.	Gallons.
Millilitre, or cubic centmetre	0·061	0·000	0 001	0·000
Centilitre, 10 cubic centimetres	0·610	0·000	0·017	0·002
Decilitre, 100 cubic centimetres	6·102	0·003	0·176	0·022
Litre, or cubic decimetre	61·027	0·035	1·760	0·220
Decalitre, or centistere	610·270	3·353	17·607	2·200
Hectolitre, or decistere	6102·705	3·531	176·077	22·009
Kilolitre, or stere, or cub. met.	61027·051	35·316	1760·773	220·096

MEASURES OF WEIGHT (UNIT GRAMME).

Equal to	Grains.	Avoirdupois lb.	Cwt. = 112lb.	Tons = 20 cwt.
Milligramme	0·015	0·000	0·000	0·0000
Centigramme	0·154	0·000	0·000	0·0000
Decigramme	1·543	0·000	0·000	0·0000
Gramme	15·432	0·002	0·000	0·0000
Decagramme	154·323	0·022	0·000	0·0000
Hectogramme	1543·234	0·220	0·001	0·0000
Kilogramme	15432·348	2·204	0·019	0·0009

SQUARE, OR MEASURE OF SURFACE.

Equal to	Square feet.	Square Yards.
Square Metre	10·7643	1·196

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FOREIGN MONEYS AND THEIR ENGLISH EQUIVALENTS.

COUNTRY.	GOLD COINS. Denominations.	Sterling Value.	SILVER COINS. Denominations.	Intrinsic Value with Silver at per Troy Oz.		
				33*d*.	36*d*.	39*d*.
		£ s. d.		s. d.	s. d.	s. d.
*America	*See* United States					
Argentine Republic	Argentino or 5-peso piece	0 19 10	Peso of 100 centesimos	2 2	2 4½	2 6½
*Austria-Hungary	Ducat	0 9 4	*Florin or gulden* of 100 kreutzer	1 1	1 2	1 3
	8-florin or gulden piece	0 15 10½	½-florin	0 3½	0 8½	0 3½
Belgium	*See* France and footnote					
Brazil	10 milreis	1 2 5½	1 milreis of 1,000 reis	1 1½	1 2½	1 3⅔
Chili, Columbia, Uruguay	Doubloon or 5-peso piece	0 18 9	1 peso of 100 centavos	2 2	2 4½	2 6½
China	.....	....	Tael of 10 mace or 100 conderin or 1,000 cash	3 6½	3 10½	4 2
Denmark	10-crown piece	0 11 0½	1 *crown* of 100 ore	0 7	0 7½	0 8
Egypt	100-piastre piece (Egyptian £)	1 0 8½	1 piastre	0 1½	0 1½	0 1½
Finland	10-markkaa piece	0 7 11½	1 markka of 100 penni	0 5	0 5½	0 6
†France	10-franc piece	0 7 11½	5-franc piece	2 2	2 4½	2 6½
			1 *franc* of 100 centimes	0 4⅔	0 5⅓	0 5⅔
*German Empire	Crown of 10 reichsmarks	0 9 9½	1 *reichsmark* or mark of 100 pfennige	0 5⅔	0 6⅓	0 6⅔
*Great Britain	Sovereign of 20 shillings	1 0 0	Crown of 5 shillings	2 6½	2 8½	2 11½
			Shilling of 12 pence	0 6	0 6½	0 7
*Greece	*See* France and footnote					
*Holland and Java	Ducat	0 9 4½	Rixdaler of 2½ florins	2 3	2 5½	2 8
	10-florin piece	0 16 6½	*Florin* of 100 cents	0 10⅔	0 11⅔	1 0⅔
India	Mohur of 15 rupees	1 9 2½	Rupee of 16 annas, 64 pice, or 192 pies	1 0½	1 1½	1 2½
Italy	*See* France and footnote					
Japan	10-yen piece	2 0 11⅔	1 yen of 100 sen	2 3⅔	2 6⅓	2 8⅔
Mexico	10-peso piece	2 0 5½	1 peso of 100 centavos	2 4	2 6½	2 9
*Netherlands	*See* Holland					
*Norway and Sweden	*See* Denmark and footnote					
Ottoman Empire	Turkish pound of 100 piastres	0 18 0⅔	1 piastre of 40 paras	0 1⅓	0 1⅓	0 1⅓
Persia	Toman of 100 shahis	0 9 5	Khran of 20 shahis	0 4⅔	0 5	0 5⅓
Peru	10-sol piece	1 19 7⅔	Sol of 10 dineros or 100 cents	2 2	2 4½	2 6½
*Portugal	Crown of 10 milreis	2 4 4½	*Teston* of 100 reis	0 2⅔	0 3	0 3
Roumania	*See* France and footnote					
*Russia	Imperial of 10 roubles	1 11 9	Rouble of 100 kopecks	1 8½	1 10½	2 0½
			Tchetvertak or ¼-rouble	0 5	0 5½	0 6
Servia and Bulgaria	*See* France and footnote					
*Spain	Doubloon of 10 escudos	1 0 7½	5-peseta piece	2 2	2 4½	2 6½
	25-peseta piece	0 19 10	Peseta of 100 centimos	0 4⅔	0 5⅓	0 5⅔
*Switzerland	*See* France and footnote					
Tunis	10-piastre piece	0 4 9½	Piastre	0 8⅓	0 8⅓	0 8⅓
Turkey	*See* Ottoman Empire					
*United States	Eagle of 10 dollars	2 1 1½	Trade dollar	2 4	2 6⅓	2 9
			Dollar of 100 cents	2 3½	2 6	2 8½
			½-dollar of 50 cents	1 0½	1 2	1 3½
Uruguay	*See* Chili and footnote					
Venezuela	*See* Peru and footnote					

EXPLANATORY NOTES.—France, Belgium, Italy, Greece, and Switzerland constitute what is known as the "Latin" Union, and their coins are alike in weight and fineness, occasionally differing, however, in name. The same system has been in part adopted by Spain, Servia, Bulgaria, Russia, and Roumania, but they have not joined the Union. Francs and centimes of France, Belgium, and Switzerland are respectively designated lire and centesimi in Italy; drachmai and lepta in Greece; dinars and paras in Servia; pesetas and centimos in Spain; leys and banis in Roumania; leva and stotinkis in Bulgaria. Similarly the Scandinavian countries, Norway, Sweden, and Denmark, employ coins of the same weight and fineness, their names being also alike. Most of the South American States possess a standard coin, equal in weight and fineness to the silver five-franc piece, generally termed a "peso." In Hayti the corresponding coin is a "gourde."

In all British Colonies, English money of every denomination is current. The exchange value of the money of those countries indicated by a * is determined by the rate of exchange for the day. The rate given in the daily papers generally represents the number of the standard coins (those printed in italics) that are equivalent to one sovereign. The Spanish rate is given in terms of the old dollar (=2 escudos). The value of other silver coins is approximately determined by the market value of silver, and must therefore be sought in one of the columns headed "Intrinsic Value with Silver at per Troy Ounce." The exchange value of the rupee depends on the rate for "India Council Bills." In "bimetallic" countries pure gold is generally taken as being worth 15½ times its weight of pure silver. This proportion corresponds to giving standard silver a constant value of 60½d.

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IMPORT DUTY LEVIABLE ON ELECTRICAL MACHINERY AND APPARATUS

IN THE UNDERMENTIONED COLONIES.

Revised for this DIRECTORY, *up to December, 1893, by the Commercial Department of the Board of Trade.*

Colony, and Tariff Classification.	Rates of Duty.
BARBADOES—	
All kinds	Free.
BRITISH GUIANA—	
All kinds	Free.
CANADA—	
Glass Telegraph and Lightning Rod Insulators	5cts. per doz., and 30 per cent. *ad val.*
Electric Light Shades, Globes (not being incandescent light globes) and Lamps	30 per cent. *ad val.*
Telephones and Telegraph Instruments, Telegraph, Telephone and Electric Light Cables, Electric and Galvanic Batteries, Electric Motors and Apparatus for Electric Lights, including Incandescent Light Globes and Insulators of all kinds (N.E.S.)	25 per cent. *ad val.*
Electric Arc Light Carbons or Carbon Points not exceeding 12in. in length	$2·50 per 1,000 and so in proportion for greater or less lengths.
Steam Engines (other than portable), Boilers and Machinery composed wholly or in part of iron and steel	30 per cent. *ad val.*
Portable Machines or Steam Engines and parts thereof	35 per cent. *ad val.*
CAPE OF GOOD HOPE—	
Materials for use in construction of telegraph lines	Free.
Other	12 per cent. *ad val.*
CEYLON—	
Magneto-electric Engines, their boilers, generators, fittings, connections, and gearing	Free.
Other	6½ per cent. *ad val.*
INDIA—	
All kinds	Free.
JAMAICA—	
All kinds	Free.
MAURITIUS—	
All kinds	7½ per cent. *ad val.*, with a surtax of 10 per cent. on the duty so leviable.
NATAL—	
Machinery, or component parts thereof, to be driven by steam, water or animal power	Free.
Other	5 per cent. *ad val.*
NEWFOUNDLAND—	
Machinery and Parts of Machinery	10 per cent. *ad val.*
Patented Machinery (for new industries in the Colony) which cannot be manufactured in the Colony	Free.
Other	25 per cent. *ad val.*
NEW SOUTH WALES—	
China and Porcelain Ware	15 per cent. *ad val.*
Other	10 per cent. *ad val.*

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Colony and Tariff Classification.	Rates of Duty.
NEW ZEALAND—	
Electric Machinery and Appliances, including Electro-motors and Hand Dynamos, Cells for batteries, &c.	Free.
Engines for electric lighting machinery	20 per cent. *ad val.*
Electric Globes, Electric Brackets, Electroliers, &c., being fittings for distributing the light	Free.
Telephones	Free.
Electrical apparatus for surgeons' use	Free.
Electric Batteries and Magneto-Electric Machines	15 per cent. *ad val.*
Electric Bell Fittings, except cells for batteries	20 per cent. *ad val.*
Earthen and Stone Ware, China and Porcelain	20 per cent. *ad val.*
QUEENSLAND—	
Machinery for Telegraphic Purposes	Free.
Gas and Portable Engines	Free.
Other	15 per cent. *ad val.*
SOUTH AUSTRALIA—	
Telephones	Free.
Engines, portable and gas	Free.
Other Engines and parts thereof	25 per cent. *ad val.*
Other Machinery	20 per cent. *ad val.*
Electric Bells and Bell Indicators	25 per cent. *ad val.*
Otherwise	20 per cent. *ad val.*
Glass Ware, Globes, and Carbons for electric lighting	15 per cent. *ad val.*
Brown Earthenware and Stone Ware	20 per cent. *ad val.*
Other Earthenware and China Ware	15 per cent. *ad val.*
Other fittings or appliances unenumerated	10 per cent. *ad val.*
STRAITS SETTLEMENTS—	
All kinds	Free.
TASMANIA—	
Engine fittings	5 per cent. *ad val.*
Engines and Machinery of all kinds (except hand machines)	7½ per cent. *ad val.*
Other	15 per cent. *ad val.*
TRINIDAD AND TOBAGO—	
All kinds	Free.
VICTORIA—	
China Ware, Earthenware, and Porcelain, being telegraphic materials	Free.
Machines and Machinery for telegraphic purposes (but not including the motive power thereof)	Free.
Electric Fittings:—viz., Arc lamps without globes, carbons, incandescent lamps, automatical resisters, transmitters or transformers, and storage batteries	Free.
Lightning Conductors	Free.
Screws for connecting electric wires of telegraph or bell fittings, or batteries, or used in manufacture of same	Free.
Machinery and Engines of all kinds (including fittings for pipes and tubes)	35 per cent. *ad val.*
Electroliers	35 per cent. *ad val.*
Portable Engines	25 per cent. *ad val.*
WESTERN AUSTRALIA—	
Machinery and parts	5 per cent. *ad val.*
Telegraph and Telephone materials, including instruments	5 per cent. *ad val.*
Earthen, Stone, and China Ware	15 per cent. *ad val.*
Other	15 per cent. *ad val.*

NOTE.—In the tariffs of several of the Colonies, dealt with in this table, there is no separate reference to *electrical* machinery and apparatus. In such cases the rates of duty are given for those classes of articles with which the various kinds of electrical machinery and apparatus would probably be grouped, but it is not always certain how the tariff would be interpreted by the local customs authorities.

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RATES OF IMPORT DUTY LEVIABLE ON DYNAMO-ELECTRIC MACHINERY AND ELECTRIC LAMPS

IN THE UNDERMENTIONED EUROPEAN COUNTRIES AND THE UNITED STATES.

Revised for this DIRECTORY, *up to December, 1893, by the Commercial Department of the Board of Trade.*

Countries, and Tariff Classification.	Rates of Duty.	English Equivalents.
AUSTRIA-HUNGARY—	Fls. Kr.	£ s. d.
Dynamo-electric Machines	100 kilos. 5·00	Cwt. 0 5 1
Electric Lamps	,, 50·00	,, 2 10 10
BELGIUM—		
Dynamo-electric Machinery—		
The duties are assimilated to those on machines and machinery of all kinds, which are—	Frs. Cts.	
Machinery of cast iron	100 kilos. 2·00	Cwt. 0 0 9¾
Ditto of wrought iron or steel	,, 4·00	,, 0 1 7½
Ditto of copper or other metal	,, 12·00	Cwt. 0 4 10½
Electric Lamps	10 per cent. *ad val.*	10 per cent. *ad val.*
BULGARIA—	8½ per cent. *ad val.*	8½ per cent. *ad val.*
DENMARK—	Kron. Öre.	
Dynamo-electric Machines	*Pund 0·02 1/2	*Cwt. 0 2 4
Electric Lamps	According to material of which composed.	
FRANCE—		
Dynamo-electric Machines—	Frs. Cts.	
Weighing from 10 and up to 50 kilogrammes	100 kilos. 80·00	Cwt. 1 12 6
,, ,, 50 ,, ,, 1,000 ,,	,, 30·00	,, 0 12 6
,, 1,000 kilogrammes and above	,, 20·00	,, 0 8 2
Electric Lamps—		
Incandescent lamps of glass—		
With their mountings	,, 350·00	,, 7 2 3
Not with mountings	,, 700·00	,, 14 4 6
Arc lamps (regulators)	,, 75·00	,, 1 10 6
GERMANY—		
Dynamo-electric Machines (so far as they cannot be described as "*Lokomotiven*" or "*Lokomobilen*")—	Mks. Pf.	
Preponderating material being of cast iron	100 kilos. 3·00	Cwt. 0 1 6½
Ditto, ditto, of wrought iron	,, 5·00	,, 0 2 6½
Ditto, ditto, of other common metal	,, 8·00	,, 0 4 0¾
Electric lamps—		
Incandescent ("*Glüh*") lamps of glass in conjunction with other materials, so far as the same cannot be classed as hardwares, &c., with the exception of cases in which platinum wire is used	,, 24·00	,, 0 12 2
Electric arc ("*Bogen*") lamps and other electric lamps	According to material of which composed.	
GREECE—	Free.	Free.
Dynamo-electric Machines		
Electric Lamps—	Drs. Lep.	
If of glass	Oke 1·00	Cwt. 1 12 0
If of plain porcelain	100 okes 50·00	,, 0 16 0
If of porcelain, inlaid, coloured or gilt	,, 200·00	,, 3 4 0
All others	According to material of which made.	
HOLLAND—		
Dynamo-electric Machinery	Free.	Free.
Electric Lamps and appliances for electric lighting, not forming part of the machinery	5 per cent. *ad val.*	5 per cent. *ad val.*

* Or 10 per cent. *ad valorem* at the option of the importer.

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Countries, and Tariff Classification.	Rates of Duty.	English Equivalents.
ITALY—	Lire Cts.	£ s. d.
Dynamo-electric Machines	100 kilos. 25·00	Cwt. 0 10 2
Weighing up to 1,000 kilos	,, 16·00	,, 0 6 6
,, more than 1,000 kilos		
Detached parts of dynamo electric machines	,, 25·00	,, 0 10 2
Electric Lamps of bronze, brass, steel or iron	,, 30·00	,, 0 12 2
Ditto of other materials	According to material of which made.	
NORWAY—		
Dynamo-electric Machinery	Free.	Free.
Electric Lamps	According to material of which chiefly made.	
PORTUGAL—		
Electric Apparatus and Machinery for whatever purpose	30 per cent. *ad val.*	30 per cent. *ad val*
Electric Lamps	According to material of which made.	
ROUMANIA—	Lei. b.	
Dynamo-electric Machines	Free.	Free.
Electric Lamps	100 kilos. 50·00	Cwt. 1 0 4
RUSSIA—	Rbls. Cop.	
Dynamo-electric Machines of all kinds	Poud 4·80	Cwt. 2 7 3
Electric Lamps	,, 6·80	,, 3 7 0
SPAIN—	Pes. Cts.	
Dynamo-electric Machines	100 kilos. 20·00	Cwt. 0 8 2
Electric Lamps; chargeable as ordinary lamps according to material of which composed, as follows:—		
Of copper	,, 125·00	,, 2 10 0
,, cast iron	,, 8·50 to 17·50	,, 0 3 5½ to 0 7 1¼
,, wrought iron	,, 25·00 to 36·00	,, 0 10 2 to 0 14 8
,, tin plate	,, 50·00	,, 1 0 4
,, other common metals	,, 37·50 to 45·00	,, 0 15 3 to 0 18 3
,, glass and crystal	,, 50·00 to 110·00	,, 1 0 4 to 2 4 9
,, earthenware	,, 37·00 to 120·00	,, 0 15 3 to 2 8 9
,, porcelain	,, 52·50 to 120·00	,, 1 1 4 to 2 8 9
SWEDEN—		
Dynamo-electric Machinery	10 per cent. *ad val.*	10 per cent. *ad val*
Electric Lamps	*According to material of which chiefly made.	
SWITZERLAND—	Frs. Cts.	
Dynamo-electric Machines	100 kilos. 4·00	Cwt. 0 1 7½
Electric Lamps	,, 6·00	,, 0 2 5½
TURKEY	8 per cent. *ad val.*	8 per cent. *ad val.*
UNITED STATES—		
Dynamo-electric Machines	45 per cent. *ad val.*	45 per cent. *ad val.*
Electric Lamps, of metal	45 per cent. *ad val.*	45 per cent. *ad val.*
,, ,, of glass	60 per cent. *ad val.*	60 per cent. *ad val.*

* This information is given by the Swedish authorities under reserve, as they are unable to give an absolute decision.

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THE FRENCH CUSTOMS TARIFF.

THE following extracts from the French Customs Tariff, which came into definite operation on the 1st February, 1893, relate to Electrical Goods. It will be seen that no reference is made to a tax on Insulated Cables, Telephonic Apparatus, Switches, &c. We are informed by the London Chamber of Commerce that the Minimum Tariff will apply to British products:—

Tariff No.	ARTICLE.	General tariff per 100 kilogrammes.	Minimum tariff per 100 kilogrammes.
		francs.	francs.
191	GRAPHITE OR PLUMBAGO	Exempt.	
193	BITUMEN	dito	
200	PLATINUM AND GOLD—		
	(*a*) Ore	dito	
	(*b*) Crude; in mass, bars, ingots, powder, broken up articles	10	10
	(*c*) *Thread, Sheet, or Wire.*—Fine drawn, simply laminated, in bars of at least 5mm. thickness, in sheets of at least 1mm. thickness, or as wire of at least 2mm. diameter	10	10
221	COPPER—		
	(*a*) Ore	Exempt.	
	(*b*) *Pure or alloyed with Zinc or Tin*—		
	Crude; in mass, bars, pig, or sheet	dito	
	Laminated, or beaten into bars or plates	13	10
	In wire of any dimension (polished or unpolished) other than gilded or silvered	13	10
224	ZINC—Sheet	4	4
238	SULPHURIC ACID	Exempt.	
239	LEAD OXIDES—		
	(*a*) Minium	5	2
	(*b*) Litharge and other oxides	5	2
302	CARBONS PREPARED FOR ELECTRIC LIGHTING	75	50
349	GLASS INSULATORS	6	4.5
361	INCANDESCENT ELECTRIC LAMPS, capped (*munies de leur monture*)	400	350
361 (bis.)	INCANDESCENT ELECTRIC LAMPS, uncapped	800	700
475	TUBES AND CONDUITS OF BITUMENED PAPER	1.25	1
504	LARGE CLOCKWORK. Clock movements, ditto telegraph instruments, counters, and every so-called clockwork movement, except that of a watch, complete or incomplete, with or without motor systems	100	75
505	ELECTRICITY COUNTERS	100	75
510	STATIONARY STEAM ENGINES, HEAT, GAS, PETROLEUM, HOT AIR, AND COMPRESSED AIR ENGINES—		
	250 kilogrammes and more	18	12
	Less than 250 kilogrammes	30	20
511	SEMI-PORTABLE STEAM ENGINES	17	13
524	DYNAMO-ELECTRIC MACHINES—		
	1,000 kilogrammes and upwards	30	20
	50 kilogrammes to 1,000 kilogrammes	45	30
	10 kilogrammes up to and less than 50 kilogrammes	100	80
526	STEAM BOILERS, iron or steel, simple or furnished with feed-water heaters, internal furnaces, but without tubes	12	9
526 (bis.)	STEAM BOILERS, iron or steel, tubular or semi-tubular, that is to say, having iron, steel, copper, or brass tubes	18	14
536	ARMATURES OF DYNAMO ELECTRIC MACHINES and separate parts, such as solid or hollow metal bobbins wound with insulated copper wire; worked copper pieces, weighing less than 1 kilogramme, numbered and marked, mounted or unmounted; intended for electric apparatus and arc lamps	100	75
576	LEAD PIPING, and all other kinds of lead work	4	3
576 (bis.)	ELECTRIC ACCUMULATORS	17	13
578	WORKED ZINC, ordinary, united or stamped	12	8
620	INDIA RUBBER AND GUTTA PERCHA MATERIALS—		
	(*a*) India rubber sheet; pure unvulcanised and vulcanised rubber thread	60	40
	(*b*) Belts, tubes, valves, and other India rubber and gutta percha work, pure or mixed, soft or hard, combined or uncombined with cloth or other material	90	70
634	OPTICAL, MATHEMATICAL, ASTRONOMICAL, AND OTHER INSTRUMENTS OF PRECISION	Exempt.	

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THE McKINLEY TARIFF ACT.

THE following comparison of the Tariff established in the United States by the passing of the McKinley Act, with the previous duty, will be of interest to our readers. The List is made up from various sources, and we are informed by the American Consular Office that it is reliable. The rates given below are now under revision by the American House of Representatives, and a new Tariff will probably come into operation in June, 1894.

	PREVIOUS RATE.		M'KINLEY RATE.
Chromic acid	15 %	...	6c.
Sulphuric acid or oil of vitriol	Free	...	¼c.
Alumina, alum, alum cake, patent alum, sulphate of alumina, and aluminous cake and alum in crystals or ground	6/10c.	...	6/10c.
Ammonia.—Carbonate	20 %	...	1¾c.
Muriate or salammoniac	10 %	...	¾c.
Sulphate	20 %	...	½c.
Blue vitriol or sulphate of copper	3c.	...	2c.
Borax.—Crude or borate of soda or borate of lime	3c.	...	3c.
Refined borax	5c.	...	5c.
Copperas or sulphate of iron	3/10c.	...	3/10c.
Castor oil, per gallon	80c.	...	80c.
Cottonseed oil, per gal. of 7½lb. weight	25c.	...	10c.
Flaxseed, or linseed and poppyseed oil: raw,	25c.	...	32c.
boiled or oxidised, per gal. of 7½lb. weight	Free	...	35 %
Varnishes.—Gold size or Japan	40 %	...	35 %
Other varnishes	40 %	...	$1.32
In addition, on spirit varnishes for the alcohol contained therein, per gallon	3c.	...	3c.
Lead Products.—Litharge, per lb.	3c.	...	3c.
Red lead, per lb.	3c.	...	3c.
Potash.—Bichromate and chromate, per lb.	3c.	...	3c.
Soda —Bichromate and chromate, per lb.	25 %	...	25 %
Earthenware, stoneware, crucibles, plain	60 %	...	60 %
China and porcelain	55 %	...	55 %
If plain white, not decorated	55 %	...	60 %
If ornamented or decorated	45 %	...	60 %
Glass.—Flint, pressed, not decorated	45 %	...	60 %
Glass.—Decorated	45 %	...	45 %
Chemical glassware	45 %	...	60 %
Blown glassware	45 %	...	60 %
Porcelain or opal	45 %	...	60 %
Lenses			
Iron and Steel.—Iron in pigs, kentledge, speigeleisen, ferro-manganese, fello-silicon, and scraps, but nothing shall be deemed scrap iron or scrap steel except waste or refuse iron or steel fit only to be re-manufactured, per lb.	3/10c.	...	3/10c.
Bar iron, comprising flats not less than 1in. wide ⅜in. thick, per lb.	8/10c.	...	8/10c
Round iron, ¾in. diameter and square iron ¾in. square, per lb.	1c.	...	9/10c
Bar, round and flats less than above, per lb.	1 1/10c.	...	1c.
Round iron less than 7/16in. diameter, and bars or shapes of rolled iron not otherwise provided for, per lb.	1 2/10c.	...	1 1/10c
Iron bars, blooms, billets made by charcoal fuel, per ton	$22	...	$22
Iron structural shapes, per lb.	1¼c.	...	9/10c
Plate iron not thinner than No. 10 wire gauge valued at 1c. per lb.	1¼c.	...	5/10c.
Not above 1 4/10c. per lb.	1¼c.	...	65/100c
Not above 2c. per lb.	1¼c.	...	8/10c.
Not above 3c. per lb.	1¼c.	...	1 9/10c.
Not above 4c. per lb.	1¼c.	...	1½c.
Not above 7c. per lb.	1¼c.	...	2c.

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Iron and Steel—(*continued*).	PREVIOUS RATE.		M'KINLEY RATE.
Not above 10c. per lb.	$1\frac{1}{4}$c.	...	$2\frac{8}{10}$c.
Not above 13c. per lb.	$1\frac{1}{4}$c.	...	$3\frac{1}{2}$c.
Above 13c. per lb.	$1\frac{1}{4}$c.	...	45 °/₀
Provided that all plate iron or steel thinner than number ten shall pay duty as iron or steel sheet.			
Forgings of iron or steel, per lb.	$2\frac{1}{2}$c.	...	$2\frac{3}{10}$c.
Provided that no forgings shall pay a less duty than 45 per cent. *ad valorem.*			
Plates of iron or steel, coated with tin or lead, per lb.	1c.	...	$2\frac{2}{10}$c.
Ingots, blooms, slabs, shafting, castings, valued at 4c. or less, per lb.	45 °/₀	...	45 °/₀
At 1c. or less, per lb.	$\frac{4}{10}$c.	...	$\frac{4}{10}$c.
1c. and not above $1\frac{4}{10}$c., per lb.	$\frac{1}{2}$c.	...	$\frac{1}{2}$c.
$1\frac{4}{10}$c. and not above $1\frac{8}{10}$c., per lb.	$\frac{7}{10}$c.	...	$\frac{8}{10}$c.
$1\frac{8}{10}$c. and not above $2\frac{2}{10}$c., per lb.	$\frac{9}{10}$c.	...	$\frac{9}{10}$c.
$2\frac{2}{10}$c. and not above 3c., per lb.	$1\frac{2}{10}$c.	...	$1\frac{2}{10}$c.
Above 3c. and not above 4c., per lb.	$1\frac{6}{10}$c.	...	$1\frac{6}{10}$c.
Above 4c. and not above 7c., per lb.	2c.	...	2c
Above 7c. and not above 10c., per lb.	$2\frac{3}{4}$c.	...	$2\frac{1}{10}$c.
Above 10c. and not above 13c., per lb.	$3\frac{1}{4}$c.	...	$3\frac{1}{2}$c.
Above 13c. and not above 16c., per lb.	$4\frac{2}{10}$c.	...	$4\frac{2}{10}$c.
Above 16c., per lb.	$3\frac{1}{4}$c.	...	7c.

	PREVIOUS RATE.		M'KINLEY RATE.
Wire rods, per lb.	$\frac{6}{10}$c.	...	$\frac{6}{10}$c.
Wire, not smaller than No. 10 wire gauge, per lb.	$1\frac{1}{2}$c.	...	$1\frac{1}{4}$c.
Smaller than No. 10, not smaller than No. 16, per lb.	2c.	...	$1\frac{3}{4}$c.
Smaller than No. 16, not smaller than No. 26, per lb.	$2\frac{1}{2}$c.	...	$2\frac{1}{4}$c.
Smaller than No. 26, per lb.	3c.	...	3c.
Any of above covered with cotton, silk, &c., corset wire (in addition) per lb.	4c.	...	5c.
*Flat steel wire, per lb.	45 °/₀	...	50 °/₀
Boiler tubes, per lb.	3c.	...	$2\frac{1}{2}$c.
Cast-iron pipe, per lb.	1c.	...	$\frac{9}{10}$c.
Steel plates, stereotype, electrotype, engraved, or lithographed	25 °/₀	...	25 °/₀
Aluminium, crude and alloys	Free	...	15 °/₀
Argentina albata or German silver, per lb.	25 °/₀	...	25 °/₀
Brass bars or pigs, old brass, yellow metal fit only for remanufacture, per lb.	$1\frac{1}{2}$c.	...	$1\frac{1}{2}$ °/₀
Copper, old, for remanufacture, per lb.	3c.	...	1c.
In plates, bars, or ingots not manufactured	4c.	...	$1\frac{1}{4}$c.
In rolled plates, rods, pipes, sheathing	35 °/₀	...	35 °/₀

* *General Provisions.*—No allowance or reduction of duties for partial loss or damage in consequence of rust or of discoloration shall be made upon any description of iron or steel, or upon any article wholly or partly manufactured of iron or steel, or upon any manufacture of iron and steel.

All metal produced from iron or its ores, which is cast and malleable, of whatever description or form, without regard to the percentage of carbon contained therein, whether produced by cementation, or converted, cast, or made from iron or its ores, by the crucible, Bessemer, Clapp-Griffiths, pneumatic, Thomas-Gilchrist, basic, Siemens-Martin, or open-hearth process, or by the equivalent of either, or by a combination of two or more of the processes, or their equivalents, or by any fusion or other process which produces from iron or its ores a metal either granular or fibrous in structure, which is cast and malleable, excepting what is known as malleable-iron castings, shall be classed and denominated as steel.

No article not specially provided for in this Act, wholly or partly manufactured from tin plate, terne plate, or the sheet, plate, hoop, band, or scroll iron or steel herein provided for, or of which such tin plate, terne plate, sheet, plate, hoop, band, or scroll iron or steel shall be the material of chief value, shall pay a lower rate of duty than that imposed on the tin plate, terne plate, or sheet, plate, hoop, band, or scroll iron or steel from which it is made, or of which it shall be the component thereof of chief value.

On all iron or steel bars or rods of whatever shape or section, which are cold-rolled, cold-hammered, or polished in any way in addition to the ordinary process of hot-rolling or hammering, there shall be paid one-fourth of one cent per pound in addition to the rates provided in this Act; and on all strips, plates, or sheets of iron or steel of whatever shape, other than the polished, planished, or glanced sheet-iron or sheet-steel hereinbefore provided for, which are cold-rolled, cold-hammered, blued, brightened, tempered, or polished by any process to such perfected-surface finish, or polish better than the grade of cold-rolled, smooth only, hereinbefore provided for, there shall be paid one and one-fourth cents per pound in addition to the rates provided in this Act upon plates, strips, or sheets of iron or steel of common or black finish; and on steel circular saw-plates there shall be paid one cent per pound in addition to the rate provided in this Act for steel saw-plates.

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	RATE.		RATE.
per lb.	2c.	...	2c.
In sheets, pipes, shot, per lb.	3c.	...	2½c
Metallic mineral substances, metals unwrought, not specially provided for	20 %	...	20 %
Mica	—	...	35 %
Nickel, nickel oxide alloy, per lb.	15c.	...	10c.
Quicksilver, per lb.	10 %	...	10 %
Zinc, in blocks or pigs, per lb.	1½c.	...	1¼c.
In sheet, per lb.	2½c.	...	2½c.
Old, for remanufacture, per lb.	1½c.	...	1¼c
Books, pamphlets, engravings, photographs, etchings, maps, charts and all printed matter not specially provided for	25 %	...	25 %
Belting	15 %	...	10 %
Manufactures of leather, fur, gutta percha, vulcanised rubber, papier maché, indurated pulp fibres	30 %	...	35 %
Manufactures of ivory, vegetable ivory, mother of pearl and shell	30 %	...	40 %

The Free List.*

Chemical or manufacturing purposes not specially provided for. Amber, unmanufactured or crude gum. Antimony ore, crude sulphide of. Asbestos, unmanufactured. Beeswax (20 %). Bismuth. Books, engravings, photographs, bound or unbound etchings, maps and charts, which shall have been printed and bound or manufactured more than twenty years at the date of importation. Books and pamphlets printed exclusively in languages other than English; also books and music in raised print (25 %). Books, engravings, photographs, etchings (bound or unbound), maps and charts imported by authority or for the use of the United States, or for the use of the library of Congress. Books, maps, lithographic prints and charts, specially imported, not more than two copies in any one invoice in good faith, for the use of any society incorporated or established for educational, philosophical, literary, or religious purposes, or for the encouragement of the fine arts, or by any college, academy, school, or seminary of learning in the United States, in its own behalf or in behalf of any of its professors or teachers, subject to such regulations as the Secretary of the Treasury shall prescribe. Books or libraries, or from foreign countries. Burgundy pitch. Catgut. Gutta-percha, crude. Indiarubber, crude, and milk of, scrap or refuse Indiarubber. Magnesium. Magnets. Manganese, oxide and ore of. Manuscripts. Minerals, crude, or not advanced by manufacture. Models of inventions and of other improvements in the arts, including patterns for machinery. Paraffin. Philosophical and scientific apparatus instruments, and preparations; statuary, casts of marble, bronze, alabaster or plaster of Paris; paintings, drawings, and etchings, specially imported in good faith for the use of any society or institution incorporated or established for religious, philosophical, educational, scientific, or literary purposes, or for encouragement of the fine arts, and not intended for sale. Platina, in ingots, bars, sheets and wire. Platinum, unmanufactured, and apparatus of platinum for chemical uses. Professional books, implements, instruments and tools of trade, occupation or employment, in the actual possession at the time of persons arriving in the United States. Wax, vegetable or mineral. Philosophical and scientific apparatus brought by professional artists, lecturers or scientists arriving from abroad for use by them temporarily for exhibition, photographic pictures for exhibition.

The Reciprocity Clauses.

On and after the first day of March, eighteen hundred and ninety-one, all articles of foreign manufacture, such as are usually or ordinarily marked, stamped, branded, or labelled, and all packages containing such or other imported articles, shall, respectively, be plainly marked, stamped, branded, or labelled in legible English words, so as to indicate the country of their origin; and unless so marked, stamped, branded, or labelled shall not be admitted to entry. Machinery for repair may be imported into the United States without payment of duty, under bond, to be given in double the appraise value thereof, to be withdrawn and exported after said machinery shall have been repaired; and the Secretary of the Treasury is authorised and directed to prescribe such rules and regulations as may be necessary to protect the revenue against fraud, and secure the identity and character of all such importations when again withdrawn and exported, restricting and limiting the export and withdrawal to the same port of entry where imported, and also limiting all bonds to a period of time of not more than six months from the date of the importation.

* The rates quoted within brackets are the old rates.

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TABLE FOR CALCULATING SALARIES.

Compiled by GARDINER WILSON, L. & N. W. Ry., Euston Station.

Multiply the Annual Salary by the Number of Days; the Amount in the Table opposite the result is the sum required.

	£	s.	d.		£	s.	d.		£	s.	d.		£	s.	d.		£	s.	d.
1	0	0	1	42	0	2	4	83	0	4	7	2500	6	17	0	6600	18	1	8
2	0	0	1	43	0	2	4	84	0	4	7	2600	7	2	6	6700	18	7	1
3	0	0	2	44	0	2	5	85	0	4	8	2700	7	7	11	6800	18	12	7
4	0	0	3	45	0	2	6	86	0	4	9	2800	7	13	5	6900	18	18	1
5	0	0	3	46	0	2	6	87	0	4	9	2900	7	18	11	7000	19	3	7
6	0	0	4	47	0	2	7	88	0	4	10	3000	8	4	5	7100	19	9	0
7	0	0	5	48	0	2	8	89	0	4	11	3100	8	9	10	7200	19	14	6
8	0	0	5	49	0	2	8	90	0	4	11	3200	8	15	4	7300	20	0	0
9	0	0	6	50	0	2	9	91	0	5	0	3300	9	0	10	7400	20	5	6
10	0	0	7	51	0	2	10	92	0	5	0	3400	9	6	4	7500	20	11	0
11	0	0	7	52	0	2	10	93	0	5	1	3500	9	11	9	7600	20	16	5
12	0	0	8	53	0	2	11	94	0	5	2	3600	9	17	3	7700	21	1	11
13	0	0	9	54	0	3	0	95	0	5	2	3700	10	2	9	7800	21	7	5
14	0	0	9	55	0	3	0	96	0	5	3	3800	10	8	3	7900	21	12	11
15	0	0	10	56	0	3	1	97	0	5	4	3900	10	13	8	8000	21	18	4
16	0	0	11	57	0	3	1	98	0	5	4	4000	10	19	2	8100	22	3	10
17	0	0	11	58	0	3	2	99	0	5	5	4100	11	4	8	8200	22	9	4
18	0	1	0	59	0	3	3	190	0	5	6	4200	11	10	2	8300	22	14	10
19	0	1	0	60	0	3	3	200	0	11	0	4300	11	15	7	8400	23	0	3
20	0	1	1	61	0	3	4	300	0	16	5	4400	12	1	1	8500	23	5	9
21	0	1	2	62	0	3	5	400	1	1	11	4500	12	6	7	8600	23	11	3
22	0	1	2	63	0	3	5	500	1	7	5	4600	12	12	1	8700	23	16	9
23	0	1	3	64	0	3	6	600	1	12	11	4700	12	17	6	8800	24	2	2
24	0	1	4	65	0	3	7	700	1	18	4	4800	13	3	0	8900	24	7	8
25	0	1	4	66	0	3	7	800	2	3	10	4900	13	8	6	9000	24	13	3
26	0	1	5	67	0	3	8	900	2	9	4	5000	13	14	0	9100	24	18	8
27	0	1	6	68	0	3	9	1000	2	14	10	5100	13	19	5	9200	25	4	1
28	0	1	6	69	0	3	9	1100	3	0	3	5200	14	4	11	9300	25	9	7
29	0	1	7	70	0	3	10	1200	3	5	9	5300	14	10	5	9400	25	15	1
30	0	1	8	71	0	3	11	1300	3	11	3	5400	14	15	11	9500	26	0	7
31	0	1	8	72	0	3	11	1400	3	16	9	5500	15	1	4	9600	26	6	0
32	0	1	9	73	0	4	0	1500	4	2	2	5600	15	6	10	9700	26	11	6
33	0	1	10	74	0	4	1	1600	4	7	8	5700	15	12	4	9800	26	17	0
34	0	1	10	75	0	4	1	1700	4	13	2	5800	15	17	10	9900	27	2	6
35	0	1	11	76	0	4	2	1800	4	18	8	5900	16	3	3	10000	27	7	11
36	0	2	0	77	0	4	3	1900	5	4	1	6000	16	8	9	20000	54	15	11
37	0	2	0	78	0	4	3	2000	5	9	7	6100	16	14	3	30000	82	3	10
38	0	2	1	79	0	4	4	2100	5	15	1	6200	16	19	9	40000	109	11	9
39	0	2	2	80	0	4	5	2200	6	0	7	6300	17	5	2	50000	136	19	9
40	0	2	2	81	0	4	5	2300	6	6	0	6400	17	10	8	60000	164	7	8
41	0	2	3	82	0	4	6	2400	6	11	6	6500	17	16	2	70000	191	15	7

EXAMPLES.—29 days at £100

29

2900 = £7 18 11

28 days at £90

28

2520 = { 2500 = £6 17 0
20 = 0 1 1

£6 18 1

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WAGES TABLE FROM 40s. TO 5s. PER WEEK.

SIX DAYS TO THE WEEK.

No. of Days.	RATES PER WEEK.																																		No. of Days.
	40/0		37/6		35/0		30/0		29/0		28/0		27/0		26/0		25/0		24/0		23/0		22/0		21/0		20/0		19/0		18/0		17/0		16/0		15/0		14/0		13/0		12/0		11/0		10/0		9/0		8/0		7/0		6/0		5/0		
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	
12	80	0	75	0	70	0	60	0	58	0	56	0	54	0	52	0	50	0	48	0	46	0	44	0	42	0	40	0	38	0	36	0	34	0	32	0	30	0	28	0	26	0	24	0	22	0	20	0	18	0	16	0	14	0	12	0	10	0	12
11	73	4	68	9	64	2	55	0	53	2	51	4	49	6	47	8	45	10	44	0	42	2	40	4	38	6	36	8	34	10	33	0	31	2	29	4	27	6	25	8	23	10	22	0	20	2	18	4	16	6	14	8	12	10	11	0	9	2	11
10	66	8	62	6	58	4	50	0	48	4	46	8	45	0	43	4	41	8	40	0	38	4	36	8	35	0	33	4	31	8	30	0	28	4	26	8	25	0	23	4	21	8	20	0	18	4	16	8	15	0	13	4	11	8	10	0	8	4	10
9	60	0	56	3	52	6	45	0	43	6	42	0	40	6	39	0	37	6	36	0	34	6	33	0	31	6	30	0	28	6	27	0	25	6	24	0	22	0	21	0	19	6	18	0	16	6	15	0	13	6	12	0	10	6	9	0	7	6	9
8	53	4	50	0	46	8	40	0	38	8	37	4	36	0	34	8	33	4	32	0	30	8	29	4	28	0	26	8	25	4	24	0	22	8	21	4	20	0	18	8	17	4	16	0	14	8	13	4	12	0	10	8	9	4	8	0	6	8	8
7	46	8	43	9	40	10	35	0	33	10	32	8	31	6	30	4	29	2	28	0	26	10	25	8	24	6	23	4	22	2	21	0	19	10	18	8	17	6	16	4	15	2	14	0	12	10	11	8	10	6	9	4	8	2	7	0	5	10	7
6	40	0	37	6	35	0	30	0	29	0	28	0	27	0	26	0	25	0	24	0	23	0	22	0	21	0	20	0	19	0	18	0	17	0	16	0	15	0	14	0	13	0	12	0	11	0	10	0	9	0	8	0	7	0	6	0	5	0	6
5	33	4	31	3	29	2	25	0	24	2	23	4	22	6	21	8	20	10	20	0	19	2	18	4	17	6	16	8	15	10	15	0	14	2	13	4	12	6	11	8	10	10	10	0	9	2	8	4	7	6	6	8	5	10	5	0	4	2	5
4	26	8	25	0	23	4	20	0	19	4	18	8	18	0	17	4	16	8	16	0	15	4	14	8	14	0	13	4	12	8	12	0	11	4	10	8	10	0	9	4	8	8	8	0	7	4	6	8	6	0	5	4	4	8	4	0	3	4	4
3	20	0	18	9	17	6	15	0	14	6	14	0	13	6	13	0	12	6	12	0	11	6	11	0	10	6	10	0	9	6	9	0	8	6	8	0	7	6	7	0	6	6	6	0	5	6	5	0	4	6	4	0	3	6	3	0	2	6	3
2	13	4	12	6	11	8	10	0	9	8	9	4	9	0	8	8	8	4	8	0	7	8	7	4	7	0	6	8	6	4	6	0	5	8	5	4	5	0	4	8	4	4	4	0	3	8	3	4	3	0	2	8	2	4	2	0	1	8	2
1	6	8	6	3	5	10	5	0	4	10	4	8	4	6	4	4	4	2	4	0	3	10	3	8	3	6	3	4	3	2	3	0	2	10	2	8	2	6	2	4	2	2	2	0	1	10	1	8	1	6	1	4	1	2	1	0	0	10	1
½	5	0	4	8	4	5	3	9	3	7	3	6	3	4	3	3	3	1	3	0	2	10	2	9	2	7	2	6	2	4	2	3	2	1	2	0	1	10	1	9	1	7	1	6	1	4	1	3	1	1	1	0	0	10	0	9	0	7	½
¼	3	4	3	2	2	11	2	6	2	5	2	4	2	3	2	2	2	1	2	0	1	11	1	10	1	9	1	8	1	7	1	6	1	5	1	4	1	3	1	2	1	1	1	0	0	11	0	10	0	9	0	8	0	7	0	6	0	5	¼
	1	8	1	7	1	6	1	3	1	2	1	2	1	1	1	1	1	0	1	0	0	11	0	11	0	10	0	10	0	9	0	9	0	8	0	8	0	7	0	7	0	6	0	6	0	5	0	5	0	4	0	4	0	3	0	3	0	2	

TABLE showing the Decimal corresponding to every Penny in the Pound.

D.	Decimal	D.	Decimal	S. D.	Decimal	S. D.	Decimal	S. D.	Decimal	S. D.	Decimal	S. D.	Decimal	S. D.	Decimal	S. D.	Decimal	S. D.	Decimal	S. D.	Decimal	S. D.	Decimal	S. D.	Decimal	S. D.	Decimal	S. D.	Decimal
1	·004	1 9	·087	3 5	·171	5 1	·254	6 9	·337	8 5	·421	10 1	·504	11 9	·587	13 5	·671	15 1	*·754	16 9	·837	18 5	·921
2	·008	1 10	·092	3 6	·175	5 2	·258	6 10	·342	8 6	·425	10 2	·508	11 10	·592	13 6	·675	15 2	·758	16 10	·842	18 6	·925
3	·012	1 11	·096	3 7	·179	5 3	·262	6 11	·346	8 7	·429	10 3	·512	**11 11**	·596	13 7	·679	15 3	·762	16 11	·846	18 7	·929
4	·017	**2 0**	·**00**	3 8	·183	5 4	·267	**7 0**	·**35**	8 8	·433	10 4	·517	**12 0**	·**600**	13 8	·683	15 4	·767	**17 0**	·**850**	18 8	·933
5	·021	2 1	·104	3 9	·187	5 5	·271	7 1	·354	8 9	·437	10 5	·521	12 1	·604	13 9	·687	15 5	·771	17 1	*·854	18 9	·937
6	·025	2 2	·108	3 10	·192	5 6	·275	7 2	·358	8 10	·442	10 6	*·525	12 2	·608	13 10	·692	15 6	·775	17 2	·858	18 10	·942
7	·029	2 3	·112	3 11	·196	5 7	·279	7 3	·362	8 11	·446	10 7	·529	12 3	·612	13 11	·696	15 7	·779	17 3	·862	18 11	·946
8	·033	2 4	·117	**4 0**	·**200**	5 8	·283	7 4	·367	**9 0**	·**450**	10 8	·533	12 4	·617	**14 0**	·**700**	15 8	·783	17 4	·867	**19 0**	·**950**
9	·037	2 5	·121	4 1	·204	5 9	·287	7 5	·371	9 1	·454	10 9	·537	12 5	·621	14 1	·704	15 9	·787	17 5	·871	19 1	*·954
10	·042	2 6	·125	4 2	·208	5 10	·292	7 6	*·375	9 2	·458	10 10	·542	12 6	·625	14 2	·708	15 10	·792	17 6	·875	19 2	·958
11	·046	2 7	·129	4 3	·212	5 11	·296	7 7	·379	9 3	·462	10 11	·546	12 7	·629	14 3	·712	15 11	·796	17 7	·879	19 3	·962
1 0	·**050**	2 8	·133	4 4	·217	**6 0**	·**300**	7 8	·383	9 4	·467	**11 0**	·**550**	12 8	·633	14 4	·717	**16 0**	·**800**	17 8	·883	19 4	·967
1 1	·054	2 9	·137	4 5	·221	6 1	·304	7 9	·387	9 5	·471	11 1	·554	12 9	·637	14 5	·721	16 1	·804	17 9	·887	19 5	·971
1 2	·058	2 10	·142	4 6	*·225	6 2	·308	7 10	·392	9 6	·475	11 2	·558	12 10	·642	14 6	·725	16 2	·808	17 10	·892	19 6	·975
1 3	·062	2 11	·146	4 7	·229	6 3	·312	7 11	·396	9 7	·479	11 3	·562	12 11	·646	14 7	·729	16 3	·812	17 11	·896	19 7	·979
1 4	·067	**3 0**	·**150**	4 8	·233	6 4	·317	**8 0**	·**400**	9 8	·483	11 4	·567	**13 0**	·**650**	14 8	·733	16 4	·817	**18 0**	·**900**	19 8	·983
1 5	·071	3 1	·154	4 9	·237	6 5	·321	8 1	·404	9 9	·487	11 5	·571	13 1	*·654	14 9	·737	16 5	·821	18 1	·904	19 9	·987
1 6	*·075	3 2	·158	4 10	·242	6 6	·325	8 2	·408	9 10	·492	11 6	·575	13 2	·658	14 10	·742	16 6	·825	18 2	·908	19 10	·992
1 7	·079	3 3	·162	4 11	·246	6 7	·329	8 3	·412	9 11	·496	11 7	·579	13 3	·662	14 11	·746	16 7	·829	18 3	·912	19 11	·996
1 8	·083	3 4	·167	**5 0**	·**250**	6 8	·333	8 4	·417	**10 0**	·**500**	11 8	·583	13 4	·667	**15 0**	·**750**	16 8	·833	18 4	·917	**20 0**	**1·0**

* EXAMPLES.—The value of the Decimal ·075 is 1s. 6d.; ·225 is 4s. 6d.; ·375 is 7s. 6d.; ·525 is 10s. 6d. ·654 is 13s. 1d.; ·754 is 15s. 1d.; 854 is 17s. 1d.; ·954 is 19s. 1d.

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POST OFFICE REGULATIONS.

INLAND RATES OF POSTAGE.

LETTERS.

The prepaid rates of postage are as follows :—

Not above 1 oz.....	1d.	Above 2 oz. but not above 4 oz.	2d.
Above 1 oz. but not above 2 oz.....	1½d.	*and so on at the rate of ½d. for every additional 2oz.*	

A letter posted unpaid is chargeable on delivery with double postage ; if insufficiently paid, with double the deficiency.

No letter may exceed 18 inches in length, 9 inches in width, or 6 in depth, unless it be sent to or from a Government Office.

REGISTRATION.

Any postal packet (parcels included), can be registered on the payment of a fee of 2d. in addition to the postage, both of which must be prepaid by means of embossed or adhesive stamps upon the cover. Such postal packet requires to be handed over the counter (and a receipt obtained) half-an-hour before the closing of the box for ordinary letters. Too-late fee 4d. The department, under certain regulations, makes good the value of the contents to the following extent, viz., to £5 if paid the registration fee only, if paid an insurance fee of an additional 1d. for £10 and a 1d. for each £5 up to £50. *Postal packets containing money* (i.e., *Coin, Bank Notes, Money or Postal Orders, Bills, Cheques, Bonds, Coupons, &c.*) *will, however, only get the benefit of this regulation if enclosed in the special registered-letter envelopes sold by the Post Office.*

POST CARDS, WRAPPERS, STAMPED ENVELOPES, &c.

Official Post Cards, impressed with halfpenny stamp, double or reply Post Cards impressed with a halfpenny stamp on each portion of them, and private Cards impressed at the Office of Inland Revenue with halfpenny stamps, may be transmitted between places in the United Kingdom with letters printed or written upon the back. *Adhesive Stamps are not accepted in payment of the postage.* Inland Post Cards are sold at the following prices :—Stout : One, ¾d. ; two, 1½d. ; three, 2d. ; four, 2½d. ; five. 3d. ; six, 3½d. ; seven, 4½d. ; eight, 5d. : nine, 5½d. ; ten, 6d. : 100, 5s. Thin : One, ¾d. ; two, 1½d. ; three, 1¾d. ; four, 2¼d. ; five, 2¾d. ; six, 3½d. ; seven, 4d. ; eight, 4½d. ; nine, 5d. ; ten, 5½d. ; 240, 11s. Foreign 1d. each. Reply Cards 2d. each. The front side of Post Cards is for the address only ; nothing else must be written, printed, or otherwise impressed on it or the stamp. On the reverse side any communication of a letter or otherwise may be written or printed. Conditions on which private cards are impressed with a halfpenny stamp can be ascertained at the Office of Inland Revenue. Adhesive stamps, except for late fee, are not accepted in payment of the postage.

Halfpenny Newspaper Wrappers at the rate of seven for 4d., and 1d. Wrappers eight for 8½d.

Stamped Envelopes at 2s. 2d. for 24, 1s. 10d. for 20, and commercial quality 1s. 9d. for 20.

BOOK POST.

The prepaid postage of a book packet is one halfpenny for every 2 oz. or part of 2 oz. If it be posted unpaid the charge is double that amount ; if partly paid double the deficiency.

The following may be sent by book post :—Books and other literary publications, photographs, prints, and drawings on paper ; and, generally, any matter wholly printed on paper or other substance in ordinary use for printing, and any written matter not being of the nature of a letter,* A book packet may also contain anything necessary for the safe transmission of any of the before mentioned articles, and legitimate binding or mounting (not consisting of glass or any brittle substance) when transmitted in the same packet with the article to which it belongs. In printed circulars it is permissible to make corrections in writing and to insert in writing the date of despatch, the name address, and description of sender, and the name of the addressee.

Book packets must not be closed in any way against examination. **They may be forwarded in open envelopes** ; if sent rolled in a wrapper it must be possible to withdraw the contents for examination, although the packet may be tied at the ends with string.

No book packet may exceed 5lbs. in weight, 18 inches in length, 9 in width, or 6 in depth, unless it be sent to or from a Government Office.

A book packet in the case of which any of these rules is infringed is chargeable, if under 8 oz. in weight, as a letter packet, and if over 8 oz. it is transferred to the Parcel Post and charged a fine of 1d., in addition to any deficient parcel postage.

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* Entries merely stating who sends the book, &c., or to whom it is given, are not regarded as a letter.

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PARCEL POST.

Parcels should be marked Parcel Post in left-hand top corner, and with the name and address of sender; but so placed as not to be mistaken for the address of the parcel. The full postage must be prepaid.

	s.	d.
For a parcel not exceeding 1 lb. in weight	0	3
For a parcel exceeding 1 lb. in weight and not exceeding 2 lb.	0	4½

And 1½d. per lb. after up to but not exceeding 11 lbs. weight.
In dimensions a parcel must not exceed 3½ft. in length, or 6ft. in length and girth combined.

PATTERN AND SAMPLE POST.

Trade patterns and samples of merchandise, open to examination, are conveyed in the United Kingdom at 1d. for 4 oz., 1½d. for 6 oz., 2d. for 8 oz. Dimensions must not exceed 12×8×4; and weight must not exceed 8 oz. Articles sent for sale or in execution of an order, or sent by a private individual, are not admissible. It is obligatory that the name, address, and trade of the sender be *printed* on the outside of the wrapper above the address. If this rule be not complied with, the packet will be charged double the deficiency at letter rate of postage.

NEWSPAPERS.

All newspapers registered at the General Post Office, London, printed and published in the United Kingdom at intervals not exceeding 7 days, may be sent singly, or in a packet, within the United Kingdom, for a postage of ½d. for each newspaper. Attention may be called to anything in the newspaper by "See p. —" or some such words (not commenting on the portion marked).

EXPRESS DELIVERY OF LETTERS AND PARCELS.

The object of the new *Post Office Express Service* is to secure the immediate delivery of messages, letters and parcels by special messenger. It is applicable not only to local packets which may be sent from one part of a town or district to another part direct by special messenger, without being forwarded in any mail bag, but also to letters and parcels sent in the first instance by the ordinary mails, either from one part of a town to another, or from one town or country district to another.

I. LOCAL SERVICE—EXPRESS THROUGHOUT.—Under this service messages, letters, and parcels, and other articles are conveyed *the entire distance* by special messenger. *In London* they are accepted at 248 Post Offices, and are delivered in any part of the London Postal Area. *In other parts of the United Kingdom* they are accepted at all Post Offices from which there is a delivery of telegrams, and are delivered in any part of the town or rural district.

The scale of charges is :—

For a letter, packet, or other article not exceeding 1lb. in weight—	
For every mile or part of a mile	3d.
For a letter, packet, or other article over 1lb. in weight—	
For every mile or part of a mile	3d.
For every lb. or part of a lb. beyond the first lb.....	1½d.

II. EXPRESS DELIVERY AFTER TRANSMISSION BY ORDINARY MAIL.—Under this service letters and parcels are forwarded by mail in the regular course of post, and on arrival at the office of delivery are sent out by special messenger.

In addition to the full ordinary postage the Express Fee is :—

For every mile or part of a mile ..... 3d.

If the sender desires that *a special conveyance* be used, or if the distance exceeds two miles, and a public conveyance is not available in both directions, the actual cost of a special conveyance (generally 1s. a mile) must be paid in addition to the above charges, under both services.

The words "Express Delivery" must in all cases be boldly and legibly marked above the address on the left-hand side of the cover (whether of letter or parcel), and in the case of an Express Mail letter the cover must in addition be marked with a *broad perpendicular line from top to bottom both on front and back.*

NOTE.—Every Packet under Service I. must be handed in over the counter. In no case may it be placed in a letter box.

Letters under Service II. may be handed in at a Post Office, or to a Rural Postman, or, if not for registration, may be posted in a letter box.

Parcels and Registered Letters under Service II. must be handed in at a Post Office, or to a Rural Postman.

SPECIAL DELIVERY OF LETTERS, &c., IN ADVANCE OF THE ORDINARY DELIVERIES BY POSTMEN.

Persons who desire at any time to receive their letters or other postal packets of any kind (including book and sample packets, parcels, newspapers, and circulars) in advance of the ordinary delivery, may have them delivered by special messenger on payment of the following fees, viz. :—

The full Express fee of 3d. a mile as for one packet, 1d for every ten, or less number, of additional packets beyond the first, and the usual weight charge of 1½d. a pound beyond the first pound on each packet.

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Applications for such special delivery must be signed by the person or firm to which the letters or postal packets in question are addressed. Forms of application may be obtained at any Post Office.

The applications should be addressed to the Postmaster or officer in charge of the Office from which the letters are ordinarily delivered, and may be delivered at such Office by hand or sent through the post prepaid. Care should be taken that the application reaches the Office on the previous evening, if it is intended to apply to the early delivery in the morning, and, if to other deliveries during the day, an hour at least before the time at which the delivery by Postmen commences.

The Express fee on at least one packet must be prepaid in stamps affixed to the application. All additional fees must be paid to the special messenger on delivery.

FOREIGN AND COLONIAL PARCEL POST.

The sender of a parcel is required to fill up a Custom House declaration, giving an accurate statement of the contents and value, date of posting, signature, and address; and, in the case of parcels for foreign countries, the net weight of the contents of the parcel.

Countries.	Weight not exceeding			Dimensions.
	3lbs.	7lbs.	11lbs.	
	s. d.	s. d.	s. d.	
Austria-Hungary, *vid* Hamburg...	1 5½	1 11½	—	2 ft. in any direction
,, ,, Belgium ...	1 9	2 2	—	
Belgium	1 3	1 8	2 2½	do.
Bulgaria	2 10	3 3	—	do.
Constantinople	1 6	2 6	3 6	Same as Inland.
,, *vid* France	2 4	2 11	—	
Denmark, ,, Hamburg.....	1 5	2 0	—	2 ft. in any direction.
,, ,, Belgium	1 9	2 2	—	
France.....	1 4	1 9	—	do.
Germany *vid* Hamburg	1 0	1 7	—	do.
,, ,, Belgium.....	1 4	1 9	—	
Greece *vid* Hamburg.....	2 6	3 0	—	Length and girth 4 ft.
Holland	1 0	1 8	2 3	2 ft. in any direction.
Italy *vid* France.....	—	2 1	—	Length and girth 4 ft.
,, ,, Belgium	2 4½	2 9½	—	
Norway	0 10½	1 5½	2 1	2 ft. in any direction.
Portugal (certain places), by Sea...	—	2 1	—	do.
Servia	2 5	2 10	—	do.
Spain (certain places)	not exceeding 6½lbs.	2 1	—	Length and girth 4 ft.
Sweden	1 2½	2 3½	—	2 ft. in any direction.
Switzerland, *vid* France	1 6	2 0	—	do.
,, ,, Belgium	1 9	2 2	—	

To the following places the rate is per lb. up to the limit of 11lbs., except for Natal, limited to 7lbs. The dimensions are the same as for Inland Parcel Post, except for Canada, 2ft. × 1ft. × 1ft.

———	Rate under		Every additional lb.
	1lb.	2lbs.	
	s. d.	s. d.	s. d.
Gibraltar and Malta	0 8	—	0 4
Cyprus	1 0	—	0 5
Egypt *vid* Thames	—	1 3	0 5
,, ,, France, not exceeding 3lbs. 2s. 6d., exceeding 3lbs and under 7lb., 3s. 2d.....	0 10	—	0 10
Canada	0 10	—	0 8
Newfoundland	0 9	—	0 6
Jamaica.....	0 9	—	0 9
Barbadoes, Grenada, St. Lucia, Tobago, and Trinidad.....	0 8	—	0 8
Leeward Islands and St. Vincent (West Indies)	0 7	—	0 7
British Guiana.....	0 10	—	0 8
Cape Colony and Durban (Natal).....	0 9	—	0 9
Natal (except Durban), British Bechuanaland, the Orange Free State, and the Transvaal (limit 7lbs.)	1 0	—	1 0
Ascension and St. Helena	0 8	—	0 8
India, Aden, Burmah, Persian Gulf, and Turkish Arabia...	1 0	—	0 8
Hong Kong and other ports in China.....	0 10	—	0 6
Ceylon and Straits Settlements.....	0 9	—	0 6
Labuan and North Borneo.....	0 11	—	0 8
Queensland, New South Wales, South Australia, Victoria, Western Australia, Tasmania, and New Zealand	—	1 6	0 9

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POSTAL TELEGRAM RATES.

The charge for any message of 12 words throughout the United Kingdom, including the Isle of Man and the Channel Isles, is Sixpence, and a halfpenny for each additional word. Names and addresses of receiver and sender *are charged for.* The cost of a reply may be prepaid, and should be, if immediate attention is required. The message may be written at the office and paid for at the time, or at home on a prepaid form and be enclosed in an envelope, addressed "Telegram, Immediate," and posted in the nearest letter box, in which latter case the message will be telegraphed to its destination from the telegraph office to which the letters included in the next collection are taken.

FOREIGN & COLONIAL TELEGRAM RATES.—(*See* TELEGRAPH TARIFFS, PAGES 207 TO 210.)

RATES OF POSTAGE TO PLACES ABROAD.*

Letters, every ½oz.	2½d.
Post Cards, Single	1d.
Do., Reply	2d.
Newspapers, Books and Printed Papers generally	½d. per 2oz.
Patterns and Samples	½d. per 2oz., with a minimum of 1d.
Commercial Papers	½d. per 2oz., with a minimum of 2½d.

MONEY ORDERS.

The commission on Inland Money Orders is:—For sums not exceeding £1, 2d.; above £1 and not exceeding £2, 3d.; above £2 and not exceeding £4, 4d.; above £4 and not exceeding £7, 5d.; above £7 and not exceeding £10, 6d. No order may contain a fractional part of a penny. Money Orders do not require a receipt stamp.

TELEGRAPH MONEY ORDERS (INLAND).

Money may be transmitted by Telegraph Money Order between all Post Offices in the United Kingdom authorised to transact Telegraph and Money Order business, with the exception that at those offices which forward but do not deliver Telegrams, Telegraph Money Orders can be issued, but cannot be paid. The commission is—For sums not exceeding £1—4d.; above £1 and not exceeding £2—6d.; above £2 and not exceeding £4—8d.; above £4 and not exceeding £7—10d.; above £7 and not exceeding £10—1s. In addition to the commission, a charge is made at the ordinary Inland rate for the Official Telegram authorising payment at the Office of Payment and for the repetition thereof, the minimum being 9d. The telegraph charges only cover the cost of transmitting the Official Telegram of Advice to the Postmaster of the Office of Payment and its repetition. Any telegraphic communication which the Remitter may wish to despatch to the Payee must be paid for at the ordinary Inland rate, the minimum being 6d.

No Telegraph Money Order can be issued for a greater amount than £10.

POSTAL ORDERS.

Postal Orders for certain fixed sums from 1s. to £1 are now issued and paid at all Money Order Offices in the United Kingdom, and at Malta, Gibraltar, Constantinople, India, Hong Kong, Straits Settlements, and Newfoundland. The following are the amounts for which Postal Orders are issued, together with the Poundage payable in respect of each Order:—

Amount.	Poundage.	Amount.	Poundage.	Amount.	Poundage.	Amount.	Poundage.
s. d.	d.	s. d.	d.	s. d.	d.	s. d.	d.
1 0 ...	½	2 6 ...	1	4 6 ...	1	10 6 ...	1
1 6 ...	½	3 0 ...	1	5 0 ...	1	15 0 ...	1½
2 0 ...	1	3 6 ...	1	7 6 ...	1	20 0 ...	1½
		4 0 ...	1	10 0 ...	1		

Broken amounts not being fractions of a penny may be made up by the use of postage stamps not exceeding 5d. in value, affixed to the face of any one Postal Order.

FOREIGN MONEY ORDERS.

The regulations are the same as for inland orders. Money orders are issued on nearly all foreign countries, British Possessions, Agencies, and Colonies, at the following rates of commission, viz.:—For sums not exceeding £2—6d.; £5—1s.; £7—1s. 6d.; £10—2s.

VALUES OF FOREIGN MONEY ORDERS IN ENGLISH CURRENCY.—(*See page* 201.)

* Except the Transvaal, Orange Free State, British Bechuanaland, and interior of Africa, *viâ* the Cape Colony or Natal, for which the rates are:—Letters, every ½oz., 4d.; Post Cards not admitted; Newspapers, Printed Papers, Books, &c., the same rates as for other places abroad.

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INLAND REVENUE STAMPS.

Impressed Bill Stamps of the respective values of 1d., 2d., 3d., 6d., 9d., and 1s. are sold at all London Sub. Offices.

Adhesive Postage and Revenue Stamps may now be used for the purpose of denoting the Stamp Duties chargeable on the following documents :—

Agreements, under hand only, where liable to the fixed duty of 6d.
Bills of Exchange (including cheques) for the payment of money *on demand* (duty 1d.).
Certified copies of, or extracts from, Registers of Births, &c. (duty 1d.).
Charter Parties (duty 6d.).
Contract Notes, advising the sale or purchase of any Stock or marketable security of a less value than £100 (duty 1d.).
Delivery Orders (duty 1d.).
Lease, or Tack, or Agreement, for a Lease or Tack, for any definite term less than a year, (*a*) of a Dwelling-house, or part of a Dwelling-house, at a rent not exceeding the rate of £10 a year (duty 1d.).
(*b*) of a Furnished Dwelling-house, or Apartments, (duties, 6d , 1s., 1s. 6d., 2s., and 2s. 6d., according to the rent).
Letters of Renunciation (duty 1d.).
Notarial Acts (duty 1s.).
Policies of Insurance (not Life or Marine—duty 1d.).
Protests of Bills of Exchange or of Promissory Notes (duties 1d., 2d., 3d., 6d., 9d., in agreement with duty on Bill or Note, and 1s. when Bill or Note is stamped with 1s. or upwards).
Proxies (where liable to the duty of 1d. only).
Receipts (duty 1d.).
Transfers of Shares in Cost Book Mines (duty 6d).
Voting Papers (duty 1d.).
Warrants for Goods (duty 3d.).

The Stamp or Stamps must be cancelled by writing the signature or initials and date across each stamp at the time the instrument is signed.

LONDON—PARIS TELEPHONE.

Communication by Telephone between London and Paris is in operation.

Public Call Offices :—General Post Office West (Bath-street), open always ; West Strand Branch Offices, open always ; Threadneedle-street Branch Post Office (near Royal Exchange), open on week days, 8 a.m. to 8 p.m.

Charge :—8s. per conversation of three minutes. Two consecutive conversations allowed.

Direct communication with Paris from office or residence can be provided by means of a line of private wire to the Telephone Room, Central Telegraph Station. Application should be made to the Secretary, General Post Office, E.C.

NOTE.—In making appointments for conversations with correspondents in Paris, the public should bear in mind that Paris time is 10 minutes in advance of London time.

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A Journal for Economists and Men of Business.

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Telegrams : "STATIST NEWSPAPER LONDON." Telephone 2714.

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TABLE

Showing the Sums payable in English Money on Money Orders issued in Foreign Countries, &c.

(From the "Post Office Guide.")

Belgium, Switzerland, and Bulgaria. †		France and Algeria, Lux'mb'rg, Italy, Tunis, and Roumania *		Germany.		Holland and Dutch East Indies.		Denmark, Iceland, and Danish West Indies.		Norway and Sweden.		Portugal, Azores, and Madeira.	Egypt.		United States, Canada and Hawaii.		English Money.		
Francs.	Cents.	Francs.	Cents.	Marks.	Pfen.	Florins.	Cents.	Kroner.	Ore.	Kroner.	Ore.	Reis.	Pounds Egyptian	Milliemes	Dollars.	Cents.	£	s.	d.
0	11	0	11	0	9	0	6	0	8	0	8	20	0	004	0	2	0	0	1
0	21	0	21	0	18	0	11	0	16	0	16	40	0	008	0	4	0	0	2
0	32	0	32	0	26	0	16	0	23	0	23	60	0	012	0	6	0	0	3
0	42	0	42	0	35	0	21	0	31	0	31	80	0	016	0	8	0	0	4
0	53	0	53	0	43	0	26	0	38	0	38	100	0	020	0	10	0	0	5
0	63	0	63	0	52	0	31	0	46	0	46	120	0	024	0	12	0	0	6
0	74	0	74	0	60	0	36	0	54	0	54	140	0	028	0	14	0	0	7
0	84	0	84	0	69	0	41	0	61	0	61	160	0	032	0	16	0	0	8
0	95	0	95	0	77	0	46	0	69	0	69	180	0	036	0	18	0	0	9
1	5	1	5	0	86	0	51	0	76	0	76	200	0	040	0	20	0	0	10
1	16	1	16	0	94	0	56	0	84	0	84	210	0	044	0	22	0	0	11
1	26	1	26	1	3	0	61	0	91	0	91	230	0	048	0	24	0	1	0
2	53	2	52	2	5	1	21	1	82	1	82	460	0	097	0	49	0	2	0
3	79	3	78	3	7	1	82	2	73	2	72	690	0	146	0	73	0	3	0
5	6	5	4	4	9	2	42	3	64	3	63	920	0	195	0	97	0	4	0
6	33	6	30	5	12	3	03	4	55	4	53	1,150	0	243	1	22	0	5	0
7	59	7	56	6	14	3	63	5	46	5	44	1,380	0	292	1	46	0	6	0
8	85	8	82	7	16	4	24	6	37	6	35	1,600	0	341	1	71	0	7	0
10	12	10	8	8	18	4	84	7	28	7	25	1,830	0	390	1	95	0	8	0
11	39	11	34	9	21	5	45	8	19	8	16	2,060	0	438	2	19	0	9	0
12	65	12	60	10	23	6	05	9	10	9	6	2,290	0	487	2	44	0	10	0
13	92	13	86	11	25	6	66	10	1	9	97	2,520	0	536	2	68	0	11	0
15	18	15	12	12	27	7	26	10	92	10	88	2,750	0	585	2	92	0	12	0
16	44	16	38	13	30	7	87	11	83	11	78	2,980	0	633	3	17	0	13	0
17	71	17	64	14	32	8	47	12	74	12	69	3,200	0	682	3	41	0	14	0
18	97	18	90	15	34	9	08	13	65	13	59	3,430	0	731	3	65	0	15	0
20	24	20	16	16	36	9	68	14	56	14	50	3,660	0	780	3	90	0	16	0
21	51	21	42	17	39	10	29	15	47	15	41	3,890	0	828	4	14	0	17	0
22	77	22	68	18	41	10	89	16	38	16	31	4,120	0	877	4	38	0	18	0
24	3	23	94	19	43	11	50	17	29	17	21	4,350	0	926	4	63	0	19	0
25	30	25	20	20	45	12	10	18	20	18	12	4,570	0	975	4	87	1	0	0
50	60	50	40	40	90	24	20	36	40	36	24	9,140	1	950	9	74	2	0	0
75	90	75	60	61	35	36	30	54	60	54	36	13,710	2	925	14	61	3	0	0
101	20	100	80	81	80	48	40	72	80	72	48	18,280	3	900	19	48	4	0	0
126	50	126	0	102	25	60	50	91	0	90	60	22,850	4	875	24	35	5	0	0
151	80	151	20	122	70	72	60	109	20	108	72	27,420	5	850	29	22	6	0	0
177	10	176	40	143	15	84	70	127	40	126	84	31,990	6	825	34	9	7	0	0
202	40	201	60	163	60	96	80	145	60	144	96	36,560	7	800	38	96	8	0	0
227	70	226	80	184	5	108	90	163	80	163	8	41,130	8	775	43	83	9	0	0
253	0	252	0	204	50	121	00	182	0	181	20	45,700	9	750	48	70	10	0	0

In calculating amounts payable in the United Kingdom, it must be understood that the Foreign Offices of Exchange reserve to themselves the power of dealing with fractions of a penny as they may deem most convenient. For example, an Order issued in Denmark for 1 Kroner may be credited to this country either as 1s. 1d. or 1s. 2d. An Order issued in Switzerland for 53 Francs may be credited either as £2. 1s. 10d. or £2. 1s. 11d.

* AUSTRIA AND HUNGARY.—The amounts of Money Orders issued in Austria or Hungary in Florins and Kreutzers are converted at the Offices of Vienna or Buda-Pesth, as the case may be, into the French currency of Francs and Centimes, in accordance with the current value of the Piece of 20 Francs in Gold on the day of the despatch of the Advice Lists to London. The sums so advised are converted at the London Office into sterling money at the rates shown in this Column.

† BULGARIA.—The amounts of Money Orders issued in Bulgaria, and payable in the United Kingdom, are advised in the first instance to Switzerland, whence they are re-advised, in Francs and Centimes, by the Swiss Post Office to London.

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LAND LINES OF THE WORLD.

COUNTRIES.	Length of Lines in Miles.			Length of Conductors in Miles.			Pneumatic Tubes. (Yards).
	Aerial.	Under-ground.	Total.	Aerial.	Under-ground.	Total.	
Germany	61,650	3,927	65,577	201,505	26,473	227,978	85,068
South Australia	5,575	—	5,575	12,630	—	12,630	—
Austria	17,417	44	17,461	49,323	618	49,941	38,759
Belgium	4,328	11	4,339	20,166	193	20,359	—
Bosnia Herzegovina	1,762	—	1,762	3,807	—	3,807	—
Bulgaria	2,920	—	2,920	5,259	—	5,259	—
Denmark	2,620	4	2,624	7,115	86	7,201	—
Egypt	3,772	—	3,772	7,413	—	7,413	—
Spain	15,561	89	15,650	34,507	218	34,725	—
France, Continent and Corsica	53,284	1,089	54,373	167,924	9,825	177,749	273,452
„ Algeria	4,295	16	4,311	9,712	166	9,878	—
Great Britain and Ireland	29,965	813	30,778	168,410	25,550	193,960	90,626
Greece	3,787	1	3,788	4,663	1	4,664	—
Hungary	11,924	—	11,924	31,231	—	31,231	—
British India (India Office)	38,536	—	38,536	119,880	—	119,880	—
Dutch Indies	4,247	7	4,254	5,638	31	5,669	—
French Indo-China	1,515	1	1,516	2,418	15	2,433	—
Italy	21,622	—	21,622	66,659	—	66,659	—
Japan	8,162	—	8,162	25,203	—	25,203	—
Luxemburg	259	—	259	508	—	508	—
Norway	4,493	—	4,493	8,942	—	8,942	—
New Zealand	5,338	—	5,338	13,210	—	13,210	—
Holland	3,153	63	3,216	11,161	411	11,572	—
Roumania	3,439	9	3,448	7,388	41	7,429	—
Russia	74,406	178	74,584	148,946	231	149,177	—
Senegal	1,501	11	1,512	2,038	11	2,049	—
Servia	1,846	—	1,846	3,088	—	3,088	—
Sweden	5,403	64	5,467	14,446	89	14.535	—
Switzerland	4,423	68	4,491	11,507	388	11,895	—
Tunis	1,398	5	1,403	2,537	5	2,542	—
Victoria	4,142	1	4,143	9,049	44	9,093	—
Indo-European Persian Gulf System	2,091	—	2,091	3,384	—	3,384	—
Indo-European Teheran, Bushire Line	673	—	673	2,021	—	2,021	—
*Western Union Company	189,234	—	189,234	737,774	—	737,774	—
	594,741	6,401	601,142	1,919,462	64,396	1,983,858	487,905

* The figures of the Western Union Company alone are given for the United States, as no others were obtainable.

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TELEGRAPHIC COMMUNICATION

BETWEEN

GREAT BRITAIN AND FOREIGN COUNTRIES AND COLONIES.

Specially compiled for this Directory and Handbook.

EUROPE.

THE Continent of Europe is connected with Great Britain by the cables of the following Governments and Companies :—

Eastern.—Triplicate cables to Portugal and Gibraltar—touching at Vigo and Cadiz, in Spain, with a duplicate continuation to the Island of Malta, from whence a line extends to Zante. From Zante a network of cables belonging to the same company connects Trieste (Austria), Otranto (Italy), Greece, Turkey, and almost all the Greek and Turkish islands.

From Portugal, the cable of the Europe and Azores Telegraph Company extends to San Miguel and Fayal in the Azores. Other Islands in the Azores are connected by cables belonging to the Portuguese Government.

Lines from Marseilles to Bona and Malta, and from Modica (Sicily) to Malta, afford alternative routes between Malta and Great Britain.

Direct Spanish.—This company possesses a cable between the Lizard and Bilbao, in Spain, also a short cable from Marseilles to Barcelona.

Government Cables.—Six cables to France, two to Belgium, two to Holland, and three to Germany are owned and worked by the British, French, Belgian, Dutch, and German Governments. These cables form the chief means of telegraphic communication between this country and Western and Central Europe.

Great Northern.—This company by its five cables from England, one to Sweden, two to Norway, and two to Denmark, with continuations to Sweden and Russia, connects Great Britain with Northern Europe. Telegraphic communication between France and the North of Europe is kept up by two cables from Calais to Fanoe (Denmark), belonging to this company.

Indo-European.—This company accepts messages for Southern Russia along its leased lines to Odessa, from which place telegrams are carried forward to Turkey by the cable of the Black Sea Company.

AMERICA AND WEST INDIES.

The North Atlantic is crossed by ten cables, belonging to the Anglo-American (4), Commercial Cable (2), Direct United States (1), French Atlantic (1), and American Telegraph and Cable (2) Companies.

The cables of the latter company are worked by the Western Union Company.

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Bermuda is connected with International telegraphy by a cable from Halifax, Nova Scotia, belonging to the Halifax and Bermuda Telegraph Company, and the Bahama Islands are connected with Florida by a Government cable from Jupiter Inlet (Florida) to Nassau.

Telegrams for the West Indies are forwarded by the lines of the International Ocean Telegraph (worked by the Western Union) from Florida to Havana, thence by the Cuba Submarine Company along the shores of the island of Cuba, to Santiago, where the lines of the West India and Panama Company commence. The latter company's system embraces almost all the West Indian Islands, and extends to Berbice and Demerara in British Guiana and to Colon (Isthmus of Panama).

La Société Française des Télégraphes Sous-Marins has cables from the island of Cuba to Hayti and on to Port Plata, with a land line across the island to San Domingo, and thence by cable to Curaçoa (Dutch) and on to La Guayra, in Venezuela. From Puerto Plata a second system runs to Martinique, Paramaribo in Dutch Guiana, Cayenne in French Guiana, and Vizeu in Brazil.

For Central America and the West Coast of South America messages are carried by the cables of the Mexican Telegraph Company, from Galveston (Texas) to Tampico and Vera Cruz in Mexico. At this place the lines of the Central and South American Company commence, and carry telegrams on to Goatzacoalcos (Mexico), whence a land line connects Salina Cruz on the Pacific. There is also a direct cable from Galveston to Goatzacoalcos, belonging to the Mexican Telegraph Company. From Salina Cruz the Central and South American Company's cables extend to Lima (Peru), calling at Libertad (Salvador), San Juan del Sur (Nicaragua), San Pedro Gonzalez, Panama, Buenaventura (Colombia), St. Elena (Ecuador), and Payta (Peru), Lima, Iquique, and on to Valparaiso. The same Company has a duplicate cable from Salina Cruz to Chorillos, calling at Juan del Sur and Santa Elena.

From Lima the lines of the West Coast of America Telegraph Company also extend along the coast to Concepcion, calling at Mollendo and Arica in Peru, and Iquique, Antofagasta, Caldera La Serena and Valparaiso in Chili.

The East Coast of South America is connected by the lines of the Eastern Company to Lisbon, and the Brazilian Submarine from thence to Pernambuco.

From Pernambuco the lines of the Western and Brazilian Company extend northward to Para, calling at Ceara and Maranham, and southward there are duplicate cables to Rio Grande do Sul, calling at Bahia, Rio de Janeiro, Santos, and Santa Catarina. The same company also works the duplicate cables of the Platino and Montevidean and Brazilian Telegraph Companies from Rio Grande do Sul to Montevideo, calling at Chuy and Maldonado. The cables of the River Plate Telegraph Company connect Montevideo and Buenos Ayres.

The land lines of the Argentine Government and the Transandine Telegraph Company connect the cables on the East Coast with those on the West Coast of South America, Buenos Ayres to Valparaiso.

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AFRICA.

Northern Africa is connected by the cables of the Eastern Company from Gibraltar to Tangier, Malta to Tripoli, Malta to Egypt (2), and Trieste and Otranto (Italy) to Egypt through Zante and Crete. The Spanish Government also work cables to Alboran, Melilla, Ceuta, Alhucemas, Penon de la Gomera, and Tangier.

The Eastern Company has land lines through Egypt from Alexandria and Port Said to Suez, from which place it has four cables to Aden, two of the latter calling at Suakin and three at Perim. From Perim the cables of the Italian Government extend to Assab and Massowah, the Eastern Company also work cables to the French settlement of Obock, and to the Turkish Station of Sheik Seyd in the province of Yemen. The Turkish Government own a cable from Suakim to Djeddah, whence land lines extend to various towns in the province of Hedjaz.

The Eastern and South African Company's cables commence at Aden and are laid along the East Coast of Africa to Durban, calling at Zanzibar, Mozambique, and Delagoa Bay. From Zanzibar branch cables extend to the Seychelles and Mauritius, also to Mombasa, Bagamayo, and Dar-es-Salaam; the cables to the two latter places are the property of the German Government. This company also owns cables from Cape Town to Mossamedes, Benguela, and Loanda, where a junction is effected with the lines of the West African Company, thus affording a duplicate route, *via* the West Coast, with the South African States.

From Durban the Government land lines extend to other parts of Natal, Transvaal and the Orange Free State. From Cape Town the Government lines reach all parts of Cape Colony and into the territory of the British South Africa Company as far as Fort Salisbury.

The ports along the West Coast of Africa are connected by the cables of the African Direct, Spanish National, and West African Companies. St. Vincent, the starting place of the African Direct Company, is connected with Europe by means of the Eastern Company's cables to Lisbon, and the line of the Brazilian Submarine from Lisbon *via* Madeira. From St. Vincent the cables extend to Bonny, calling at St. Iago, Cape de Verd Islands, Bathurst, Sierra Leone, Accra, Lagos and Brass.

The Spanish Government own and work the cable between Cadiz and the Canary Islands.

The Spanish National Company own the cable between the Canary Islands and Saint Louis in Senegal. Saint Louis and Dakar are connected by a cable belonging to the India Rubber Company. From St. Louis the South American Company's cables extends to Pernambuco, calling at Fernando de Noronda.

The West African Company's line is divided into two sections. The first start, from Dakar and extends to Sierra Leone, with stations at Bathurst, Bissao, Bolama, and Conakry. The second section commences at Grand Bassam, and has landing places at Accra, Kotonou, and St. Thomé; another line starts from Bonny to Principe and St. Thomé, thus forming duplicate communication by aid of the African Direct cables between the latter place and Accra. Numerous Stations in the Gold Coast are connected by Government land lines from Accra extending to Lomé and Little Popo in German Territory. From St. Thomé cables are laid to Gaboon and Loanda. From Bonny the German Government cable connects the Cameroons, and from Kotonou the French Government have a line to Whydah.

Cadiz, the starting place of the Canary Islands cable, is connected with Great Britain by the cables of the Eastern Company *via* Vigo, *via* Lisbon, or *via* Gibraltar, and by the cable of the Direct Spanish Company *via* Bilbao.

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ASIA AND OCEANIA.

There are two main routes between Great Britain and India, viz.: those of the Eastern and Indo-European Companies.

The Eastern Company's route goes through Malta, which is reached by triplicate and duplicate cables through Lisbon and Gibraltar, and by a special leased line through France to Marseilles, thence by duplicate cables touching at Bona; from Malta by triplicate cables to Alexandria, land lines through Egypt, quadruple cables down the Red Sea to Aden, and triplicate cables to Bombay.

The Indo-European Company's duplicate lines cross the North Sea, traverse Germany and Russia, to Teheran in Persia. From this place the land lines are maintained by the Indian Government as far as Bushire, whence the Government cables are laid along the Persian Gulf to Jask, Gwadur and Kurrachee. There is a cable also from Bushire to Fao in Turkey.

The land lines of the Indian Government connect Bombay and Kurrachee with Madras, the starting point of the Eastern Extension, Australasia and China Company's cables.

The duplicate cables from Madras to Penang, Malacca, Singapore, Sumatra, Java, and Port Darwin in Australia belong to the Eastern Extension Company. From Port Darwin the land lines of the South Australian Government cross the continent to Adelaide, whence land lines extend to all parts of Australia. A third cable has been laid between Java and Australia, landing at Roebuck Bay in Western Australia, which place is connected by land lines with the rest of Australia. From Penang the native State of Perak is connected, and from Malacca land lines extend to the States of Selangor, Sunjie Ujung, and Jelebu. From Penang there is also a cable connecting Deli and Acheen (in the Dutch Indies). The cable between Penang and Singapore has recently been triplicated.

The duplicate cables between New South Wales and New Zealand and Victoria and Tasmania belong to the Eastern Extension Company.

From Queensland the cable of the Société Francaise des Télégraphes Sans Marins connects New Caledonia.

The Eastern Extension Company also possess cables from Singapore to Cochin China, Tonquin, Hong Kong, Manila (Philippine Islands), Macao, Foochow, and Shanghai. From Cochin China land lines extend to the Kingdom of Siam.

Another route to China is by the Great Northern Company's lines to Libau in Russia, thence by land lines across Russia *viâ* Siberia to Wladiwostock on the Pacific. The Chinese and Russian Governments telegraph systems are connected at the Helampo-Blagowestchensk frontier.

From Wladiwostock the Great Northern Company has duplicate cables to Nagasaki (Japan) and Shanghai; also single cables from Shanghai to Amoy and Hong Kong, and from Nagasaki to the Island of Tsushima and Fusan in Corea.

The land lines of the Chinese Government connect the interior of China and Corea with the cables of the Eastern Extension and Great Northern Companies at Shanghai, Amoy, Foochow, and Hong Kong. The Chinese Government also possess cables connecting the Islands of Hainan and Formosa.

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TELEGRAPH TARIFF PER WORD FROM THE UNITED KINGDOM TO ALL PARTS OF THE WORLD.

CORRECTED TO DECEMBER, 1893.

The following Companies Collect and Deliver Messages at the Addresses given :—

Name of Company, and Indication of Route for use on Messages handed in at Postal Offices.	London Stations.	Provincial Stations.
EASTERN ..... *"Via Eastern."*	11, Old Broad-street 8, Leadenhall-street 3, Great Tower-street 42, Parliament-street 37, Holborn-viaduct 206A, Winchester-house, E.C. Foreign Auction Hall, Covent Garden	Liverpool : K13, Exchange-bldgs. Manchester : 20, Brown-street. Glasgow : 5, Royal Bank-place
INDO-EUROPEAN... *"Via Indo."*	18, Old Broad-street 9, East India-avenue 10 & 11, Mincing-lane	Liverpool : 6, Water-street. Manchester : 60, Spring-gardens
GREAT NORTHERN.. *"Via Northern."*	3, St. Helen's-place	Newcastle. Aberdeen.
DIRECT SPANISH *"Via Spanish."*	74, Gracechurch-street 280, Winchester-house, Old Broad-street Foreign Auction Hall, Covent Garden	.....
ANGLO-AMERICAN *"Via Anglo."*	23, Throgmorton-st. 109, Fenchurch-street 2, Northumberland-av., Charing-cross 46, Mark-lane, E.C. Tooley-st. (Hay's wf.)	Liverpool : A1, The Exchange. Manchester : 7, Royal Exchange. Glasgow : 29, Gordon-street. Bristol : Baldwin-street. Bradford : 10, Forster-square Dundee : 1, Panmure-street Edinburgh : 106, George-street Leith : Exchange-buildings. Newcastle-on-Tyne : 1, Side.
COMMERCIAL CABLE ..... *"Via Commercial."*	23, Royal Exchange 16, Mark-lane, E.C. 11, Duke-street, S.E. 1, Northumberland-av. East India-avenue, Leadenhall-st., E.C.	Liverpool : F3, Exchange-bldgs. Glasgow : 67, St. Vincent-street. Glasgow : 40, Hope-street. Bristol : Baldwin-street. Manchester : 18, Moult-street. Bradford : 8, Forster-square. Newcastle-on-Tyne : 29, Sandhill. Edinburgh : 82, George-street. Leith : 5, Bernard-street. Dundee : 37, Albert-square. Cardiff : Cory's-corner, Bute Dks. Swansea : 15, Adelaide-street. Weston-super-Mare : Richmond-st.
DIRECT UNITED STATES..... *"Via Direct."*	34, Throgmorton-st. South Sea House, Threadneedle-street East India-avenue, Leadenhall-street Mincing-lane	Liverpool : D6, Exchange-bldgs. Bristol : Baldwin-street. Glasgow : 40, Hope-Street.
FRENCH ATLANTIC CABLE *"Via P. Q."*	24, Royal Exchange	.....
WESTERN UNION. *"Via Western Union."*	21, Royal Exchange 109, Fenchurch-street 40, Mark-lane..... Arundel-street, Strand	Liverpool : A5, Exchange-bldgs. Glasgow : 29, Gordon-street. Bristol : Baldwin-street.

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TELEGRAPH TARIFF PER WORD FROM THE UNITED KINGDOM TO ALL PARTS OF THE WORLD.

EUROPE.

DESTINATION OF MESSAGE.	NAME OF COMPANY.				
	EASTERN.	INDO-EUROPEAN.	GREAT NORTHERN.	DIRECT SPANISH.	GOV'RNMENT CABLES.
	s. d.	s. d.	s d.	s. d.	s. d.
ALGERIA	0 9	...	...	...	0 3*
AUSTRIA	0 10	...	...	...	0 3*
AZORES	0 10	...	...	...	0 10
BELGIUM	...	...	...	...	0 2*
BOSNIA, HERZEGOVINA	...	...	...	...	0 4
BULGARIA	0 7	...	...	...	0 4½
CYPRUS	1 7	...	...	...	0 6½
DENMARK	...	...	0 3½	...	0 3½
FRANCE	...	...	...	...	0 2*
GERMANY	...	...	0 4	...	0 2*
GIBRALTAR	0 4½	...	...	0 4½	0 4½
GREECE AND ISLANDS	0 7	...	...	...	0 7
HOLLAND	...	...	...	...	0 2*
HUNGARY	0 10	...	...	...	0 3*
ITALY	0 7	...	...	...	0 3*
LUXEMBOURG	...	...	...	...	0 2½*
MALTA	0 6	...	...	...	0 6
MONTENEGRO	...	...	...	...	0 4
NORWAY	...	...	0 3½	...	0 3½
PORTUGAL	0 4½	..	...	0 4½	0 4½
ROUMANIA	0 7	...	...	...	0 4
RUSSIA IN EUROPE	1 0	0 5½	0 5½	...	0 5½
RUSSIA IN ASIA (1ST REGION)	...	...	1 8	...	1 8
RUSSIA IN ASIA (2ND REGION)	...	...	2 7	...	2 7
SERVIA	...	...	...	...	0 4
SPAIN	0 4	...	...	0 4	0 4
SPAIN (*via* Marseilles and Barcelona).	...	...	...	0 7	0 7
SWEDEN	...	...	0 4	...	0 4
SWITZERLAND	...	...	...	...	0 3*
TANGIER	0 6	...	...	0 6	0 6
TRIPOLI	1 1	...	...	...	1 1
TUNIS	0 10	...	...	...	0 3*
TURKEY IN EUROPE AND ASIA AND ISLANDS	0 6½	0 11	0 11	...	0 6½

* Telegrams to these places by the route of the Government cables are subject to a minimum charge of five words.

AMERICA AND WEST INDIES.

DESTINATION OF MESSAGE.	NAME OF COMPANY.		DESTINATION OF MESSAGE.	NAME OF COMPANY.	
	EASTERN.	ATLANTIC.		EASTERN.	ATLANTIC.
AMERICA.	s. d.	s. d.		s. d.	s. d.
COSTA RICA	...	4 2	HONDURAS (Republic)	...	3 9
GUATEMALA—			SALVADOR—		
San Jose	...	3 1	Libertad	...	3 6
Other places	...	3 4	All other places	...	3 9
NICARAGUA—			ISTHMUS OF PANAMA	...	5 0
San Juan del Sur	...	3 11	ARGENTINE REPUBLIC	5 9	5 9
All other places	...	4 2	BOLIVIA	7 8	6 2

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TELEGRAPH TARIFF PER WORD FROM THE UNITED KINGDOM TO ALL PARTS OF THE WORLD—(*continued*).

DESTINATION OF MESSAGE.	NAME OF COMPANY.	
	EASTERN.	ATLANTIC.
	s. d.	s. d.
BRAZIL	...	...
Pernambuco	5 4	5 9
All other places	5 9	5 9
BRITISH GUIANA	...	12 2
CHILI	8 10	6 2
COLOMBIA, UNITED STATES OF		
Buenaventura	12 0	5 6
Isthmus of Panama	...	5 0
All other places	12 0	5 9
DUTCH GUIANA—		
Paramaribo	...	9 10
ECUADOR	11 3	6 2
FRENCH GUIANA—		
Cayenne	9 6	10 8
All other places	9 6	10 10
PARAGUAY	5 9	5 9
PERU	8 2	6 2
URUGUAY	5 9	5 9
VENEZUELA	...	10 11
MEXICO—Chihuahua, Guaymas, Hermosillo, Matamoras, Monterey, Sabinas, Saltillo, Sauz	...	1 9
Mexico City, Tampico, Vera Cruz	...	2 6
All other places	...	2 8
UNITED STATES AND CANADA		
Cape Breton, Connecticut, Maine, Massachusetts, New Brunswick, Newfoundland, New Hampshire, Hoboken, Jersey City, (New Jersey), New York (New York City, Brooklyn, Yonkers), Nova Scotia, Ontario, Prince Edward Island, Quebec, Rhode Island, St. Pierre, Miquelon, Vermont	...	1 0
District of Columbia, Delaware, Maryland, New Jersey (except Hoboken and Jersey City), New York (except New York City, Brooklyn, Yonkers), Pennsylvania	...	1 2
Alabama, Georgia, Illinois, Indiana, Kentucky, Louisiana (New Orleans) Michigan, Minnesota (Duluth, Minneapolis, St. Paul), Mississippi, Missouri (St. Louis), North Carolina, Ohio, South Carolina, Tennessee, Virginia, West Virginia, Wisconsin	...	1 3
Arkansas, Colorado, Dakota, Florida (except	...	1 5

DESTINATION OF MESSAGE.	NAME OF COMPANY.	
	EASTERN.	ATLANTIC.
	s. d.	s. d.
U.S. & CANADA—(*continued*).		
Key West & Pensacola), Indian Territory, Iowa, Kansas, Louisiana (except New Orleans), Minnesota (except Duluth, Minneapolis, St. Paul), Missouri (except St. Louis), Montana, Nebraska, New Mexico, Oklahoma Territory, Texas, Wyoming	...	1 5
Arizona, British Columbia, California, Idaho, Manitoba, Nevada, North W. Territories (Alberta, Assinoboia, Saskatchewan), Oregon, Utah, Vancouver Island, Washington (State)	...	1 6
Florida—		
Key West	...	1 8
Pensacola	..	1 3
All other places	...	1 5
WEST INDIES.		
ANTIGUA	...	9 10
BAHAMAS—		
Nassau (New Providence)	...	2 5
BARBADOES	...	9 11
BERMUDAS	...	4 0
CUBA—Bayamo, Guantanamo, & Manzanillo	...	2 10
Cienfuegos	...	3 6
Havana	...	2 8
Santiago	...	4 9
All other places	...	2 10
CURACAO	...	9 2
DOMINICA	...	9 2
GRENADA	...	9 11
GUADELOUPE	...	9 0
JAMAICA	...	5 10
MARIE GALANTE	...	9 4
MARTINIQUE	...	9 0
PORTO RICO	...	9 0
ST. CROIX	...	9 4
ST. KITTS	...	9 10
ST. LUCIA	...	9 2
ST. THOMAS	...	9 1
ST. VINCENT	...	9 6
SAN DOMINGO—		
Hayti, Republic of—		
Cap Haitien, Port-au-Prince	...	7 10
Gonaives, Jacmel, Miragoane, Petitgoare, and St. Marc	...	8 5
Mole St. Nicholas	...	6 10
All other places	...	8 11
TRINIDAD	...	10 5

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TELEGRAPH TARIFF PER WORD FROM THE UNITED KINGDOM TO ALL PARTS OF THE WORLD—(*continued*).

AFRICA AND ADJACENT ISLANDS.

DESTINATION OF MESSAGE.	NAME OF COMPANY. EASTERN.	DIRECT SPANISH.	DESTINATION OF MESSAGE.	NAME OF COMPANY. EASTERN.	DIRECT SPANISH.
	s. d.	s. d.	SOUTH AFRICA—(*continued*)	s. d.	s. d.
ASSAB	3 10	...	Cape Colony, Transvaal and Orange Free State.	8 11	...
CANARY ISLANDS	0 10*	0 10*	British South Africa Co.'s Stations	9 2	...
CAPE DE VERD ISLANDS—			TANGIER	0 6*	0 6*
St. Vincent	2 6	2 6	TRIPOLI	1 1*	...
St. Jago	3 5	3 5	WEST COAST—		
EAST COAST—			Accra	8 0	8 0
German E. African Stations	7 11	...	,, Govt. Stations	8 2	8 2
Delagoa Bay	8 10	...	Bathurst	5 11	5 11
Imperial British East African Co.'s Stations	8 2	...	Benguella	9 10*	9 10*
Mauritius	8 9	...	Bissao and Bolama	4 7*	4 7*
Mombasa	7 9	...	Bonny and Brass	9 8	9 8
Mozambique	8 10	...	Cameroons	9 10	9 10
Seychelles	7 3	...	Conakry	4 7*	4 7*
Zanzibar	7 9	...	Gaboon	6 9*	6 9*
EGYPT—			Grand Bassam	5 1*	5 1*
Alexandria	1 7	...	Lagos	8 10	8 10
1st Region, including Cairo, Suez, & Port Said	1 10	...	Lome and Little Popo	8 4	8 4
2nd Region	2 0	...	Loanda	8 7*	8 7*
Suakin	2 6	...	Mossamedes	10 9*	10 9*
MASSOWAH	3 11	...	Porto Novo or Kotonou	6 3*	6 3*
MADEIRA	1 2	1 2	Principe	7 1*	7 1*
OBOCK	3 10	...	San Thomé	6 7*	6 7*
SOUTH AFRICA—			Senegal	1 6*	1 6*
Natal (Durban)	8 9	...	Sierra Leone	6 9	6 9
Natal (other places)	8 11	...	Whydah	6 3*	6 3*

* These telegrams are subject to the European system of charging.

ASIA AND AUSTRALASIA.

DESTINATION OF MESSAGE.	NAME OF COMPANY. EASTERN.	INDO-EUROPEAN.	GREAT NORTHERN.	DESTINATION OF MESSAGE.	NAME OF COMPANY. EASTERN.	INDO-EUROPEAN.	GREAT NORTHERN.
	s. d.	s. d.	s. d.		s. d.	s. d.	s. d.
ANNAM	5 10	5 10	...	INDIA	4 0	4 0	...
ARABIA—				Burmah	4 2	4 2	...
Aden & Perim	3 9	...	...	Ceylon	4 1	4 1	...
Hedjaz *via* Jeddah	3 9	...	...	JELEBU	5 8	5 8	...
YEMEN—				MALACCA	5 7	5 7	...
via Sheik Seyd	4 4	...	...	MANILA	9 0	9 0	9 0
AUSTRALASIA				PAHANG	5 8	5 8	...
South and West—				PENANG	5 0	5 0	...
Australia	4 9	4 9	...	PERAK	5 2	5 2	...
New South Wales	4 11	4 11	...	PERSIA *via* Bombay	5 5	1 6	1 6
New Zealand	5 2	5 2	...	,, ,, Malta	1 11	...	...
Queensland	9 5	9 5	...	PERSIAN GULF—			
Tasmania	5 5	5 5	...	Bushire *via* Bmby	4 5	2 5	...
Victoria	4 10	4 10	...	,, ,, Malta	2 0	...	...
New Caledonia	10 3	10 3	...	Other stations *via* Bombay	4 5	3 7	...
CHINA—				,, ,, *via* Malta	3 2	...	...
Macao	7 6	7 6	7 6	SELANGOR	5 8	5 8	...
Other stations	7 0	7 0	7 0	SIAM—			
COCHIN CHINA	5 1	5 1	...	*via* Singapore	5 7	5 7	...
COREA	7 0	7 0	7 0	*via* Moulmein	4 6	4 6	...
DUTCH INDIES—				SINGAPORE	5 9	5 9	...
Java	6 0	6 0	...	SUNJIE UJÖNG	5 8	5 8	...
Other Islands	6 6	6 6	...	TONQUIN	6 3	6 3	...
JAPAN	10 8	10 8	8 0				

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THE SUBMARINE CABLES OF THE WORLD.

Extracted from the Official Document issued by The International Bureau of Telegraphic Administrations, Berne.

(WITH CORRECTIONS TO DATE AND ADDITIONS.)

SUMMARY OF CABLES OWNED BY GOVERNMENT ADMINISTRATIONS.

(*See* List of Cables owned by British Government Administrations given on pages **213** to **217**.)

COUNTRY.	No. of Cables with one or more cores.	Length in Nautical Miles.	
		Of Cables.	Of Conductors.
Argentine Republic	3	35·090	105·270
Austria	31	104·940	112·960
Bahamas	1	213·000	213·000
Brazil	22	34·580	46·646
Belgium	* 2	54·250	278·500
Canada (*see* List of Cables, p. 216)	21	206·500	206·500
Cochin China and Tonquin	2	795·000	795·000
Denmark	* 58	208·925	573·090
Dutch Indies	4	483·010	483·010
France	* 55	4,053·666	4,543·470
Germany	* 46	1,761·945	3,454·290
Great Britain and Ireland (*see* List of Cables, pp. 213 to 215).	*128	1,759·289	5,663·895
Greece	48	452·247	452·247
Holland	20	60·370	81·320
India, Indo-European Telegraph Department Government Administration (*see* List of Cables, pp. 215 and 216).	92	1,974·820	1,974·820
Italy	39	1,068·480	1,132·680
Japan	31	214·731	277·454
New Caledonia	1	1·000	1·000
New Zealand	3	196·315	284·945
Norway	255	248·140	248·140
Queensland	13	162·350	165·050
Russia in Europe, and the Caucasus	8	212·680	236·240
Russia in Asia	1	70·017	70·017
Senegal	1	3·000	3·000
South Australia	5	49·900	49·900
Spain	11	1,305·100	1,305·100
Sweden	* 12	94·010	168·770
Tasmania	1	4·500	4·500
Turkey in Europe and Asia	11	338·990	341·990
Victoria	1	4·500	4·500
	926	16,171·345	23,278·354

* Including half of Cables owned jointly with other Administrations.

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SUMMARY OF CABLES OWNED BY PRIVATE COMPANIES.

See List of Cables given on pp. 218 to 226.	No. of Cables with one or more cores.	Length of Cables in Nautical Miles.	Capital.†
I. Direct Spanish Telegraph Company	3	709·08	£143,724
II. Halifax and Bermuda Cable Company	1	849·96	170,000
III. Spanish National Submarine Telegraph Company.	6	1,294·969	290,190
IV. West African Telegraph Company	12	3,047	491,990
V. Black Sea Telegraph Company	1	336·522	130,000
VI. Great Northern Telegraph Company	27	6,966	1,710,000
VII. Eastern Telegraph Company	121	26,028·76	6,099,990
VIII. Eastern and South African Telegraph Company	11	6,718·655	1,155,500
IX. Eastern Extension, Australasia, and China Telegraph Company	25	16,132	3,140,800
X. Europe and Azores Telegraph Company	2	1,053·08	176,000
XI. Anglo-American Telegraph Company	14	10,400	7,000,000
XII. Direct United States Cable Company	2	3,099·52	1,214,200
XIII. Compagnie Française du Télégraphe de Paris à New York	4	3,495·85	1,680,000
XIV. Western Union Telegraph Company	12	7,743	2,800,000
XV. Commercial Cable Company	6	6,937·61	1,807,500
XVI. Brazilian Submarine Telegraph Company	6	7,376·659	1,411,400
XVII. African Direct Telegraph Company	7	2,746	431,000
XVIII. Cuba Submarine Telegraph Company	4	1,100	220,000
XIX. West India and Panama Telegraph Company	22	4,557	1,275,530
XX. Société Française des Télégraphes Sous-marins	15	4,618·04	440,000
XXI. Western and Brazilian Telegraph Company*	16	6,127	1,874,765
XXII. River Plate Telegraph Company	3	138	55,500
XXIII. Mexican Telegraph Company	3	1,529	200,000
XXIV. Central and South American Telegraph Company.	13	7,390·84	1,000,000
XXV. West Coast of America Telegraph Company	8	1,965·92	450,000
XXVI. Canadian Pacific Railway Company	5	42·30	...
XXVII. South American Cable Company	2	2,075·509	600,000
Total	351	137,478·265	35,968,089

* Including London Platino-Brazilian and Montevidean and Brazilian Companies.

† This does not include such debentures as have been redeemed.

GENERAL SUMMARY.

	No. of Cables with one or more cores.	Length in Nautical Miles of Cables.
Government Administrations	926	16,171
Private Companies	351	137,478
Total	1,277	153 649

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I.—CABLES OWNED BY BRITISH GOVERNMENT ADMINISTRATIONS.

LANDING PLACES.	Date of Laying and total No. of Cables.	No. of Conductors.	Length in Nautical Miles. Of Cables.	Of Conductors.
GREAT BRITAIN AND IRELAND.				
A. Irish Sea and St. George's Channel.				
Port Kail (Scotland) to Whitehead (Ireland)	1888	4	25·144	100·576
Port Kail (Scotland) to Donaghadee (Ireland)	1870	4	23·055	92·220
Donaghadee to Port Kail (telephone)	1893	4	23·809	95·236
Knock Bay (Scotland) to Whitehead (Ireland)	1879	4	22·884	91·536
St. Bees, near Whitehaven, to Port Cornah (Isle of Man)	1885	3	31·119	93·357
Trecastle, Anglesey, to Howth, near Dublin	1871	7	64·606	452·242
Abermawr, near Haverfordwest, to Blackwater, near Wexford (Ireland)	1880	4	55·630	222·520
Fishguard Bay (S. Wales) to Blackwater, near Wexford (Ireland)	1883	4	61·899	247·596
Aberdeirch, near Port Nevin (N. Wales), to Newcastle, County Wicklow (Ireland)	1886	4	54·860	219·440
Abergeirch, near Port Nevin (N. Wales), to Newcastle, County Wicklow (Ireland)	1892	4	60·630	242·520
B. Channel and Channel Islands.				
Compass Cove, near Dartmouth, to Fort Doyle (Guernsey)	1884	3	67·236	201·708
Alderney to Fort Doyle (Guernsey)	1870	1	18·563	18·563
St. Martin's Point (Guernsey) to Grève au Lancon (Jersey)	1884	3	16·260	48·780
Hurst Castle to Sconce Point (Isle of Wight)	1886	7	1·230	8·610
Hurst Castle to Yarmouth (Isle of Wight)	1885	3	2·345	7·035
Porthcurno to St. Mary's (Scilly Isles)	1886	1	27·534	27·534
St. Mary's (Scilly) to Isle of Trescow (Scilly)	1892	1	1·135	1·135
Bryer to Trescow (Scilly)	1892	1	0·3489	0·3489
St. Mary's to St. Agnes (Scilly)	1892	1	2·7863	2·7863
St. Mary's to St. Martin's (Scilly)	1892	1	1·6360	1·6360
Trescow to St. Martin's (Scilly)	1892	1	1·0319	1·0319
Croyde Bay to Lundy Island	1893	1	16·496	16·496
C. Orkney and Shetland Isles.				
Sanday (Orkney) to Westray (Orkney)	1891	1	11·628	11·628
Sinclair Bay, Wick, to Sandwick Bay (Shetland)	1885	1	122·634	122·634
Dunnet, near Thurso, to Rackwick Bay, Hoy Island (Orkney)	1876	1	20·845	20·845
Hoy (Orkney) to Houton Head (Mainland)	1873	1	2·360	2·360
Hoy (Orkney) to Houton Head (Mainland)	1876	1	2·360	2·360
Workhead, Mainland, to Isle of Shapinshay (Orkney)	1889	1	2·287	2·287
Rerwick Head, Mainland, to Stronsa (Orkney)	1885	1	9·848	9·848
Stronsa to Sanday (Orkney)	1884	1	3·0	3·0
Scathna Bay (Orkney) to Sandwick Bay (Shetland) (looped into Fair Isle)	1881	1	74·9277	74·9277
Mainland (Shetland) to Yell (Shetland Isles)	1890	3	2·682	8·046
Yell to Unst (Shetland)	1890	1	1·157	1·157
Burra (Orkney) to South Ronaldsha (Orkney)	1887	1	·644	·644
Burra (Orkney) to Howequay Head (Orkney)	1884	1	2·710	2·710
Shetland (Mainland) to Bressay (Shetland)	1891	1	·330	·330
Shetland (Mainland) to Whalsey (Shetland)	1891	1	5·040	5·040
D. Hebrides and Western Coasts of Scotland and Ireland.				
Loch Ewe (Scotland) to Branahuie Bay, near Stornoway (Island of Lewis, Hebrides)	1872	1	33·692	33·692
Harris (Lewis) to North Uist (Hebrides)	1886	1	11·468	11·468
South Uist to Castle Bay, Barra (Hebrides)	1884	1	16·510	16·510
Port na Cross, Fairlie, to Corrie, Arran	1885	4	9·562	38·248
Carried forward	41	90	913·228	2,560·6416

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LANDING PLACES.	Date of Laying and Total No. of Cables.	No. of Conductors.	Length in Nautical Miles. Of Cables.	Of Conductors.
Brought forward	41	90	913·228	2,560·6416
Ross-shire to Isle of Skye	1890	3	0·759	2·277
Ganovan Bay, near Oban, to the Isle of Mull.	1871	1	6·400	6·400
Glenacardock Point, Cantyre, to the Isle of Islay	1871	1	16·853	16·853
Port Cranaig, Cantyre, to Arran	1885	3	3·264	9·792
Largs to Great Cumbrae	1887	1	1·403	1·403
Ardine Point to Ardbeg Point, Bute	1881	4	1·358	5·432
Mull to Coll	1888	1	9·394	9·394
Tiree to Coll	1888	1	2·175	2·175
Rugha Ben (Scotland) to Isle of Bute	1872	1	0·443	0·443
Renard Point (Ireland) to Valentia	1870	4	0·444	1·776
Renard Point (Ireland) to Valentia	1893	4	0·4167	1·6668
Renard Point (Ireland) to Valentia	1893	4	9·4144	1·6576
Gigha to Tayenloan	1892	1	2·702	2·702
E. Eastern Coast of Scotland.				
Burghead to Helmsdale	1885	3	26·147	78·441
F. Bays and Estuaries, &c.				
Frinton to Gunfleet Lighthouse	1893	1	5·4767	5·4767
Across River Ore	1893	1	0·1703	0·1703
Across River Ore	1893	1	0·2100	0·2100
Alum Bay (Isle of Wight) to Needles Lighthouse	1893	1	1·1129	1·1129
Across the River Dart to Chain Ferry	1884	3	0·295	0·885
Across the River Dart to Chain Ferry	1888	4	0·281	1·124
Across the Port of Milford	1871	4	0·591	2·364
Across the Tees at Middlesbrough	—	4	0·160	0·640
Across the Tees at Middlesbrough	—	4	0·160	0·640
Across the Tees at Middlesbrough	—	4	0·160	0·640
Across the Tees at Middlesbrough	—	4	0·160	0·640
Across the Tees at Middlesbrough	—	4	0·160	0·640
Across the Tees at Middlesbrough	—	4	0·160	0·640
Across the Gloucester and Sharpness Canal at Sharpness	—	4	0·049	0·196
Across the Gloucester and Sharpness Canal at Sharpness	—	4	0·049	0·196
Across the Gloucester and Sharpness Canal at Sharpness	—	4	0·049	0·196
Across the Gloucester and Sharpness Canal at Sharpness	—	4	0·049	0·196
Across the Canal from Swansea Docks to Swansea	—	4	0·074	0·296
Across the River Yar, Isle of Wight	—	7	0·074	0·518
Across the River Medina, Isle of Wight	—	4	0·078	0·312
Across the River Dee at Queensferry, near Chester	—	4	0·103	0·412
Across the River Dee at Queensferry, near Chester	—	4	0·103	0·412
Across the River Dee at Queensferry, near Chester	—	4	0·103	0·412
Across Firth of Forth to Alloa	1886	1	0·275	0·275
Across Loch Etive at Connel Ferry	1882	1	0·276	0·276
Across Loch Etive at Connel Ferry	1884	4	0·280	1·120
Across Loch Eil at Corran Ferry	1885	1	1·120	1·120
Across Loch Creran at Shian Ferry	1882	1	0·611	0·611
Across Loch Creran at Shian Ferry	1882	1	0·631	0·631
Across Loch Creran at Shian Ferry	1888	4	0·658	2·632
Across Loch Leven at Ballachulich Ferry	1888	4	0·186	0·744
Across Port of Waterford (Waterford Harbour, Ireland)	1871	4	1·353	5·412
Across Port of Waterford (Waterford Harbour, Ireland)	1871	4	1·430	5·720
Across Port of Waterford (Waterford Harbour, Ireland)	1871	4	1·510	6·040
Across Port of Waterford (Waterford Harbour, Ireland)	1893	4	1·480	5·920
Across River Suir at Waterford Bridge (Ireland)	—	4	0·147	0·588
Across River Suir at Waterford Bridge (Ireland)	—	4	0·147	0·588
Across River Suir at Waterford Bridge (Ireland)	—	4	0·147	0·588
Across River Suir at Waterford Bridge (Ireland)	—	4	0·147	0·588
Across River Suir at Waterford Bridge (Ireland)	—	4	0·147	0·588
Across Bannow River (Ireland)	1893	1	0·3070	0·3070
Across River Slaney at Wexford (Ireland)	1880	7	0·340	2·380
Across River Slaney at Wexford (Ireland)	1883	4	0·343	1·372
Across River Slaney at Wexford (Ireland)	1893	4	0·3519	1·4076
Carried forward	99	274	1,016·1159	2,758·2905

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LANDING PLACES.	Date of Laying and No. of Cables	No. of Conductors.	Length in Nautical Miles. Of Cables.	Of Conductors.
Brought forward	99	274	1,016·1159	2,758·2905
New Holland to Dairycoates, near Hull	1879	7	1·436	10·052
Devonport to Torpoint	—	3	0·377	1·131
Granton (Firth of Forth) to Aberdour	1882	7	4·510	31·570
Cove to Blairmore, Loch Long	1885	7	1·550	10·850
Cove to Blairmore, Loch Long	1885	7	1·558	10·906
Keyhaven to Hurst Castle	1887	12	1·280	15·360
Strachur, Loch Fyne, to Kenmure	1870	6	1·115	6·690
Strachur, Loch Fyne, to Kenmure	1881	7	1·054	7·378
Row to Clachan Gairloch	1892	7	0·478	3·346
Row to Clachan Gairloch	1892	7	0·408	2·856
Row to Clachan Gairloch	1887	3	0·434	1·302
Whitepoint to Haulbowline (Ireland)	—	1	0·259	0·259
Whitepoint to Haulbowline (Ireland)	—	1	0·259	0·259
Whitepoint to Haulbowline (Ireland)	—	4	0·259	1·136
Haulbowline to Spike Island (Ireland)	—	4	0·384	1·536
Kilronan, Arran Islands, to Cashla Bay (Ireland)	1892	1	9·745	9·745
Cross Haven to West Seamount (Ireland)	—	2	0·185	0·370
Foyle Road to Waterside, Londonderry	—	7	0·246	1·722
Foyle Road to Waterside, Londonderry	—	4	0·246	0·984
Total	118	371	1,041·8989	2,875·7425
INTERNATIONAL SYSTEM.				
Anglo-French Cables.				
Sangatte, near Calais, to Dover (St. Margaret's Bay)	1851	4	22·187	88·748
Sangatte, near Calais, to Dover (St. Margaret's Bay)	1891	4	20·389	81·556
Cape Grisnez to Dover (Abbott's Cliff)	1859	6	20·510	123·060
Puys, near Dieppe, to Beachy Head	1861	6	62·000	372·000
Cape Antifer, near Havre, to Beachy Head	1870	6	69·359	416·154
Pirou, near Coutance, to Flicquet Bay (Jersey)	1860	1	16·750	16·750
Anglo-Belgian Cables.				
Middelkerke, near Ostend, to Ramsgate	1853	6	61·851	371·106
La Panne, near Furnes, to Dover (St. Margaret's Bay)	1866	4	46·947	187·788
Anglo-Dutch Cables *(Belonging to English Government).*				
Lowestoft to Zandvoort (Holland)	1858	4	111·139	444·556
Benacre, near Kessingland, to Zandvoort (Holland)	1884	4	108·295	433·180
Anglo-German Cables.				
Bacton to Borkum (*Joint property of English and German Governments*)	1891	4	210·90	843·60
Norderney to Lowestoft (*belongs to English Government*)	1866	4	232·509	930·036
Greetsiel near Emden, to Lowestoft, comprising the sections (*belongs to German Government*):—				
Greetsiel to Borkum / Borkum to Lowestoft	1871	4	—	—
Greetsiel, near Emden to Valentia (Ireland)	1882	1	—	—
Total	14	58	982·836	4,038·534
Deduct half of Cables owned by Great Britain in common with France, Belgium and Germany	4	20	265·446	1,250·381
International Cables belonging to Great Britain	10	38	717·390	2,788·153
Add totals of Internal System as above	118	371	1,041·899	2,875·742
Total Cables belonging to Great Britain	128	409	1,759·289	5,663·895

BRITISH INDIA.

A. Indo-European Telegraph Department.

	CABLE CONSERVANCY.	Nautical Miles of Cable.	Nautical Miles of Line.
G.P.	Karachi to Manora (4 cables)	17·34	17·34
G.P.	Manora to Jashk	531·62	531·62
G.P.	Jashk to Bushire	520·54	520·54
G.P.	Bushire to Fáo	152·39	152·39
I.R.	Jashk to Bushire	501·46	501·46
	Total (8 cables)	1,723·35	1,723·35

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LAND LINES.	Miles of Line.	Miles of Wire.
Karachi to Gwadur	762·56	762·56
Gwadur to Jashk	636·70	636·70
Total	1,399·26	1,399·26

LANDING PLACES.

B. Indian Administration.

Headquarters, Calcutta and Simla.

INTERNAL SYSTEM.

		Nautical Miles of Cable.	Nautical Miles of Conductors.
Eighty-four Cables	84 Cables	251·47	251·47
Add Indo-European Telegraph Department	8 ,,	1,723·35	1,723·35
Total	92 Cables	1,974·82	1,974·82

	Date of Laying and No. of Cables.	No. of Conductors.	Length in Nautical Miles. Of Cables.	Of Conductors.
CANADIAN GOVERNMENT TELEGRAPHS.				
Head Office, Ottawa, Canada.				
Anticosti Island—South-West Point to Gaspé	1880	1	44·25	44·25
Mechastie Bay to Mingan	1890	1	21	21
Magdalen Islands—Old Harry to Meat Cove (C. B.)	1880	1	55	55
Grindstone to All Right Islands	1880	1	0·50	0·50
Nova Scotia—Meat Cove (C.B.) to St. Paul's Island	1890	1	20	20
Across Ingonish Harbour (C.B.)	1889	1	0·25	0·25
Across St. Ann's Harbour (C.B.)	1887	1	0·25	0·25
Across Big Bras d'Or Passage	1880	1	0·50	0·50
Cape Sable Island to Bear Point	1883	1	1·25	1·25
Across Channel to Lighthouse, Bear Boint	1883	1	0·50	0·50
New Brunswick—Campo Bello Is. to Eastport (Maine, U.S.)	1880	1	1·75	1·75
Campo Bello Is. to Grand Manan Island.	1880	1	7·25	7·25
Cheney Island to Ross Island	1890	1	0·50	0·50
Ross Island to White Head Island	1890	1	0·75	0·75
Prov. of Quebec—L'Ange Gardien to Orleans Island	1884	1	0·75	0·75
Orleans Island to Isle aux Reaux	1889	1	2	2
Isle aux Reaux to Grosse Isle	1889	1	2	2
Across Saguenay River	1883	1	1·25	1·25
Bersimits to Manicougan	1883	1	12	12
Manicougan to Godbout	1883	1	26	26
Ontario—Point Pelee to Pelee Island (Lake Erie)	1889	1	8·75	8·75
Total	21	21	206·50	206·50
QUEENSLAND.				
Cleveland to Peel Island	—	1	5·0	5·0
Peel Island to Dunwich	—	1	2·15	2·15
Dunwich to South Passage	—	1	12·20	12·20
Pialba to Woody Island	—	1	7·65	7·65
Woody Island to Whitecliffs	1885	1	13·45	13·45
Rockhampton to Keppel Bay	—	1	77·35	77·35
Lytton to Lighthouse	1884	1	5·0	5 0
Mackay to Flat-Top Island	1877	1	5·0	5·0
Paterson to Thursday Island	1886	2	18·0	18·0
Cape Pallarenda to Magnetie Island	1886	1	2·75	2·75
Townsville to Magazine Island	1888	1	0·45	3·15
Magazine Island to Cape Cleveland	1888	1	11·10	11·10
Gatcombe Head to Facing Island	1886	1	2·25	2·25
Lytton to St. Helena	1879	1	3·0	3·0
Total	14	15	78·15	96·15

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LANDING PLACES.	Date of Laying and No. of Cables.	No. of Conductors.	Length in Nautical Miles. Of Cables.	Of Conductors.
SOUTH AUSTRALIA.				
Normanville to Kingscote (Kangaroo Island)	—	1	38·50	38·50
Edithburg to Lighthouse (Trowbridge Island)	—	1	5·0	5·0
Cape Spencer to Althorpe Lighthouse	—	1	—	—
Largs Bay	—	1	3·20	3·20
Largs Bay	—	1	3·20	3·20
Total	5	5	49·90	49·90
NEW ZEALAND.				
Wellington to Whites Bay (Cook Straits)	1866	3	44·315	132·945
Wellington to Whites Bay (Cook Straits)	1877	1	44·0	44·0
Wanganui to Blind Bay	1880	1	108·0	108·0
Total	3	5	196·315	284·945
TASMANIA.				
Cape Portland to Swan Island	1885	1	4·50	4·50
VICTORIA.				
Point Nepean to Swan Island	1889	1	4·50	4·50

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II.—CABLES OWNED BY PRIVATE COMPANIES.

LANDING PLACES.	Date of Laying and No. of Cables.	No. of Conductors.	Length in Nautical Miles. Of Cables.	Of Conductors.
I.—DIRECT SPANISH TELEGRAPH COMPANY. *Head Office, Winchester House, Old Broad-street, London.*				
Kennack Cove (Cornwall) to Las Arenas, near Bilbao	1884	1	487·90	487·90
Barcelona to Marseilles.....	1874	1	220·38	220·38
Two Short River Cables	1881	1	·80	·80
	3	3	709·08	709·08
II.—HALIFAX AND BERMUDAS CABLE COMPANY. *Head Office, 33, Old Broad Street, London, E.C.*				
Halifax (N.S.) to Hamilton, Bermuda	1890	1	849·96	849·96
III.—SPANISH NATIONAL SUBMARINE TELEGRAPH COMPANY. *Head Office, 106, Cannon-street, London, E.C.*				
Tejita (Tenerife) to Saint Louis du Sénégal	1884	1	864·58	864·58
Santa Cruz de Tenerife to Las Palmas, Gran Canaria	1883	1	67·24	67·24
Las Palmas to Arrecife de Lanzarote	1884	1	171·95	171·95
Garachico de Tenerife to Santa Cruz de la Palma	1883	1	69·05	69·05
†Santa Cruz de Tenerife to Tejita (Tenerife).....	1884	1	32·149	32·149
†Saint Louis (Senegal) to Dakar (Senegal)	1885	1	90	90
	6	6	1,294·969	1,294·969
IV.—WEST AFRICAN TELEGRAPH COMPANY. *Head Office, Winchester House, Old Broad-street, London, E.C.*				
Dakar (Senegal) to Bathurst (British possession)	1886	1	107	107
Bathurst to Bolama (Portuguese possession).....	1886	1	363	363
Bolama to Bissao	1885	1	44	44
Bolama to Conakry (French possession)	1885	1	238	238
Conakry to Sierra Leone (English possession)	1886	1	73	73
Grand Bassam (French possession) to Accra (English possn.)	1886	1	242	242
Accra to Kotonou (Porto Novo) (French possession)	1886	1	215	215
Kotonou to San Thome (Portuguese possession)	1886	1	486	486
San Thome to the Gaboon (Freetown) (French possession)...	1886	1	177	177
San Thome to Island of Principé (Portuguese possession) ...	1886	1	126	126
San Thome to Loanda	1886	1	783	783
Principé to Bonny.....	1889	1	193	193
	12	12	3,047	3,047
V.—BLACK SEA TELEGRAPH COMPANY. *Head Office, Winchester House, Old Broad-street, London, E.C.*				
Odessa (Russia) to Kilia, near Constantinople	74	1	336·522	336·522

† These two sections are leased by the Spanish National Company.

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LANDING PLACES.	Date of Laying and No. of Cables.	No. of Conductors.	Length in Nautical Miles. Of Cables.	Of Conductors.
VI.—GREAT NORTHERN TELEGRAPH COMPANY.				
Head Office, 26, Kongens Nytorv, Copenhagen. London Office, 3, St. Helen's-place, Bishopsgate-street Within, E.C.				
1st. Cables in Europe.				
Peterhead (Scotland) to Ekersund (Norway)	1869	1	269	269
Newbiggin (England) to Marstrand (Sweden), comprising the sections:—				
I. Newbiggin to Arendal (Norway)	1880	1	424	424
II. Arendal to Marstrand (Sweden)	1880	1	98	98
Newbiggin to Marstrand (Sweden) direct	1890	1	510	510
Newbiggin to Hirtshals (Denmark)	1873	1	423	423
Newbiggin to Sondervig (Denmark)	1868	1	343	343
Oye, near Calais (France), to Fanoe (Denmark)	1873	1	387	387
Oye (France) to Fanoe (Denmark)	1891	1	369	369
Hirtshals (Denmark) to Arendal (Norway)	1867	1	70	70
Skagen (Denmark) to Marstrand (Sweden)	1873	2	34	68
Moen (Denmark) to Island of Bornholm (Denmark)	1868	2	78	156
Bornholm (Denmark) to Libau (Russia)	1869	1	226	226
Grisslehamn (Sweden) to Nystad (Russia)	1869	1	96	96
Grisslehamn (Sweden) to Nystad (Russia)	1883	1	104	104
Grisslehamn (Sweden) to Island of Aaland (Russia)	1877	1	28	28
Aaland (Russia) to Nystad (Russia)	1876	1	57	57
2nd. Cables in Asia.				
Hongkong (China) to Amoy (China)	1871	1	325	325
Amoy (China) to Woosung, near Shanghai (China), comprising the sections:				
I. Amoy to Gutzlaff (China)	1871	1	590	590
II. Gutzlaff to Woosung	1871	1	59	59
Gutzlaff to Nagasaki (Japan)	1871	1	427	427
Woosung, near Shanghai (China), to Nagasaki (Japan), comprising the sections:				
I. Woosung to Gutzlaff	1883	3	57	171
II. Gutzlaff to Nagasaki	1883	1	417	417
Nagasaki (Japan) to Wladiwostock (Russia in Asia)	1871	1	766	766
Nagasaki (Japan) to Wladiwostock	1883	1	753	753
Island of Tsu-shima to Corea	1883	1	53	53
Kowloon (China) to Hong Kong	1884	2	2	2
Kowloon (China) to Hong Kong	1891	1	1	1
	27	32	6,966	7,192
VII.—EASTERN TELEGRAPH COMPANY.				
Head Office, Winchester House, Old Broad-street, London, E.C.				
1st. Anglo-Spanish-Portuguese System.				
Porthcurno, Land's End, to Carcavellos, near Lisbon, Portugal	1870	1	852·249	852·249
Porthcurno, Land's End, to Carcavellos, near Lisbon (Portugal)	1887	1	899·322	899·322
Porthcurno to Vigo (Spain)	1873	1	619·705	619·705
Vigo to Caminha (Portugal)	1876	1	38·165	38·165
Vigo to Carcavellos, near Lisbon (Portugal)	1873	1	265·455	265·455
Carcavellos to Gibraltar (No. 1)	1870	1	388·297	388·297
Carcavellos to Gibraltar (No. 2)	1887	1	338·913	388·913
Villa-Real de St. Antonio (Portugal) to Cadiz	1888	1	86·286	86·286
Cadiz to Gibraltar	1888	1	84·981	84·981
Cable (across Tagus):				
Belem (Portugal) (No. 1)	1885	4	1·10	4·4
Belem (Portugal) (No. 2)	1885	4	1·20	4·8
Carried forward	11	17	3,575·673	3,632·573

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LANDING PLACES.	Date of Laying and No. of Cables.	No. of Conductors.	Length in Nautical Miles.	
			Of Cables.	Of Conductors.
Brought forward	11	17	3,575·673	3,632·573
2nd. System West of Malta.				
Gibraltar to Tangier	1887	1	36·734	36·734
Gibraltar to Malta (No. 1)	1870	1	1130·347	1130·347
Gibraltar to Malta (No. 2)	1887	1	1129·762	1129·762
Marseilles (France) to Bona (Algeria) (No. 1)	1870	1	450·256	450·256
Marseilles (France) to Bona (Algeria) (No. 2)	1877	1	466·656	466·656
Bona to Malta (No. 1)	1870	1	385·731	385·731
Bona to Malta (No. 2)	1877	1	388·167	388·167
Malta to Tripoli (Africa)	1882	1	212·262	212·262
Valetta (Malta) to Pozzallo, near Modica (Sicily)	1869	1	55·976	55·976
Malta to Zante	1887	1	376·090	376·090
3rd. Italo-Greek System.				
Otranto (Italy) to Zante (Greece)	1874	1	189·186	189·186
Torre del Orso, near Otranto, to Bay of Sidari (Corfu)	1861	1	63·608	63·608
4th. Austro-Greek System.				
Trieste (Austria) to Corfu	1882	1	507·712	507·712
5th. Greek System.				
Zante to Katacolo (Morea)	1884	1	28·331	28·331
Kalamaki (Morea) to Piræus	1884	1	30·542	30·542
Kalamaki (Morea) to Piræus	1889	1	31·218	31·218
Corinth (Morea) to Patras (Morea) (No. 1)	1884	1	70·553	70·553
Corinth (Morea) to Patras (Morea) (No. 2)	1889	1	75·446	75·446
Patras (Morea) to Zante (No. 1)	1884	1	57·260	57·260
Patras (Morea) to Zante (No. 2)	1887	1	59·602	59·602
Zante to Corfu	1871	1	175·801	175·801
Syra to Piræus	1884	1	81·487	81·487
Rio Ante Rio (Patras Narrows) (No. 1)	1887	1	1·233	1·233
Eubœa to Petali	1869	1	1·750	1·750
Ithica to Cephalonia	1869	1	7·048	7·048
Morea to Spezzia	1869	1	2·511	2·511
Zante to Trepito	1870	1	14·431	14·431
Sta. Maura to Ithaca	1870	1	7·000	7·000
Cephalonia to Zante	1871	1	20·963	20·963
Tinos to Andros	1873	1	1·761	1·761
Syra to Tinos	1873	1	11·852	11·852
Andros to Eubœa (Doro Channel)	1873	1	9·215	9·215
Morea to Hydra	1873	1	4·587	4·587
Morea to Poros	1873	1	·152	·152
Eubœa to Attica (Petali Gulf)	1879	1	13·351	13·351
Morea to Cerigo	1880	1	9·464	9·464
Eubœa to Skiathos	1881	1	7·874	7·874
Eubœa to C. Stavro	1881	1	3·721	3·721
Laurium to Zea	1881	1	15·327	15·327
Naxos to Neo	1884	1	12·504	12·504
Thermia to Zea	1884	1	11·139	11·139
Tinos to Mikoni	1884	1	5·792	5·792
Mikoni to Rhenea	1884	1	5·186	5·186
Paros to Naxos	1884	1	4·704	4·704
Syra to Paros	1884	1	23·858	23·858
Nio to Santorin	1884	1	12·643	12·643
Amorgo to Naxos	1884	1	22·919	22·919
Siphano to Paros	1884	1	21·608	21·608
Milo to Siphano	1884	1	19·775	19·775
Serpho to Siphano	1884	1	10·752	10·752
Serpho to Thermia	1884	1	15·362	15·362
Poros to Methanao	1884	1	3·975	3·975
Ægina to Methana	1884	1	4·420	4·420
Daphne to Salamis	1884	1	3·783	3·783
Ægina to Piraeus	1884	1	12·488	12·488
Carried forward	66	72	9,901·548	9,958·448

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LANDING PLACES.	Date of Laying and No. of Cables.	No. of Conductors.	Length in Nautical Miles. Of Cables.	Of Conductors.
Brought forward	66	72	9,901·548	9,958·448
Bridge Eubœa to Calcis Bœotia (No. 2)	1884	1	·220	·220
Skopelo to Skiathos	1884	1	7·653	7·653
Trikerri to Vathi	1884	1	4·933	4·933
Corfu to Sta. Maura	1884	1	43·487	43·487
Corfu to Paxos	1884	1	12·243	12·243
Salamis to St. George	1885	1	·450	·450
Eubœa to Skyros	1885	1	23·896	23·896
Luxuri to Argostoli	1885	1	2·324	2·324
Anaphi to Santorin	1885	1	16·644	16·644
Nio to Sikino	1885	1	6·809	6·809
Sikino to Polykandros	1885	1	8 956	8·956
Rio to Ante Rio (No. 2) (Patras Narrows)	1891	1	1·293	1·293
Oropos to Eretria	1891	1	4·151	4·151
Kartal to Nagara	1891	1	141·856	141·856
Thermia to Syra	1892	1	32·000	32·000
6th. Turko-Greek System.				
Zante to Canea (Candia)	1873	1	256·905	256·905
Syra to Candia	1878	1	133·990	133·990
Syra to Chio (No. 1)	1873	1	96·994	96·994
Syra to Chio (No. 2)	1885	1	90·262	90·262
7th. Turkish System.				
Canea to Rettimo (Candia)	1871	1	36·069	36·069
Canea to Candia	1889	1	68·178	68·178
Rettimo to Candia	1871	1	42 909	42·909
Candia to Sitia (Candia)	1871	1	56·485	56·485
Sitia to Rhodes, comprising the sections: I. Sitia to Scarpanto; II. Scarpanto to Rhodes	1871	1	145·595	145·595
Chio to Tchesmé (Turkey in Asia) (No. 1)	1871	1	10·927	10·927
Chio to Tchesmé (No. 2)	1888	1	9·151	9·151
Chio to Tenedos	1878	1	97·443	97·443
Tenedos to Lemnos	1884	1	58·868	58·868
Lemnos to Salonica	1884	1	140·353	140·353
Tenedos to Chanac (Anatolia)	1878	1	31·000	31·000
Rumilie Hissar to Anatolia Hissar (Bosphorus)	1878	3	·672	2·016
Tenedos Besika	1878	1	4 769	4·769
8th. Egypto-European System.				
Malta to Alexandria (Egypt) (No. 1)	1868	1	931·828	931·828
Malta to Alexandria (Egypt) (No. 2)	1870	1	912·842	912·842
Sitia (Candia) to Alexandria	1873	1	359 912	359·912
Larnaca (Cyprus) to Alexandria	1878	1	328·460	328·460
9th. Egyptian System.				
Alexandria to Port Said	1882	1	154·632	154·632
10th. Egypto-Indian System.				
No. 1—1870 Red Sea Cable diverted				
Suez to Souakim (No. 1)	1884	1	950·094	950·094
Souakim to Perim	1884	1	609·985	609·985
Perim to Aden	1884	1	108·511	108·511
No. 2—1876 Red Sea Cable diverted				
Suez to Souakim (No. 2)	1891	1	811·725	811·725
Souakim to Aden	1891	1	794·882	794·882
No. 3—				
Suez to Aden	1883	1	1,403·331	1,403·331
No. 4—Red Sea				
Suez to Perim	1890	1	1,332·050	1,332·050
Perim to Aden	1890	1	100·460	100·460
Perim to Obock	1889	1	52·029	52·029
Aden to Bombay (No. 1)	1870	1	1,888·898	1,888·898
Aden to Bombay (No. 2)	1877	1	1,887·397	1,887·397
Aden to Bombay (No. 3)	1891	1	1,851·190	1,851·190
Carried forward	115	123	25,967·259	26,025·503

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LANDING PLACES.	Date of Laying and No. of Cables.	No. of Conductors.	Length in Nautical Miles. Of Cables.	Of Conductors.
Brought forward	115	123	25,967·259	26,025·503
The following Italian Cables are leased by the Company to the Italian Government, to belong to them after thirty years:—				
Milazzo to Lipari	1881	1	23·439	23·439
Selina to Milazzo	1882	1	5·961	5·961
Faro to Baghara (No. 1)	1884	3	7·815	23·445
Faro to Baghara No. 2)	1886	3	7·954	22·362
Faro to Baghara (No. 3)	1886	3	8·470	25·410
Faro to Baghara (No. 4)	1889	3	7·862	23·586
	121	137	26,028·760	26,151·206
VIII.—EASTERN AND SOUTH AFRICAN TELEGRAPH COMPANY.				
Head Office, Winchester House, Old Broad-street, London, E.C.				
Aden to Zanzibar	1879	1	1,915·594	1,915·594
Zanzibar to Mozambique (No. 1)	1879	1	650·590	650.590
Zanzibar to Mozambique (No. 2)	1885	1	692·453	692·453
Zanzibar to Mombaza	1890	1	150·430	150·430
Zanzibar to Bagamoyo	1890	1	27·622	27·622
Bagamoyo to Dar es Salaam	1890	1	46·669	46·669
Mozambique to Lourenço-Marques (Delagoa Bay)	1879	1	972·494	972·494
Lourenço-Marques to Durban (Natal)	1879	1	348·546	348·546
Cape Town to Mossamedes	1889	1	1,383·418	1,383·418
Mossamedes to Benguela	1889	1	234·719	234·719
Benguela to Loanda	1889	1	296·120	296·120
	11	11	6,718.655	6,718·655
IX.—EASTERN EXTENSION, AUSTRALASIA, AND CHINA TELEGRAPH COMPANY.				
Head Office, Winchester House, Old Broad-street, London, E.C.				
Madras to Penang	1870	1	1,487	1,487
Madras to Penang	1891	1	1,389	1,389
Penang to Singapore Triplicate	1892	1	381	381
Penang to Medan	1891	1	162	162
Penang to Malacca	1879	1	275	275
Malacca to Singapore	1879	1	116	116
Penang to Singapore	1870	1	398	398
Singapore to Saïgon (Cochin China)	1871	1	629	629
Haïphong (Tonkin) to Hong Kong	1884	1	467	467
Hong Kong to Foochow	1884	1	472	472
Foochow to Shanghai	1883	1	449	449
Saïgon to Hong Kong (China)	1871	1	990	990
Saïgon to Thuanan	1883	1	517	517
Thuanan to Doson	1884	1	256	256
Hong Kong to Macao	1884	1	37	37
Hong Kong to Cape Bolinao (Island of Luzon)	1880	1	529	529
Singapore to Batavia (Java)	1870	1	541	541
Singapore to Banjoewangie (Java)	1879	1	921	921
Banjoewangie to Port Darwin (Australia) (No. 1)	1871	1	1,134	1,134
Banjoewangie to Port Darwin (Australia) (No. 2)	1880	1	1,125	1,125
Banjoewangie to Roebuck Bay (Australia)	1889	1	892	892
Flinders, near Melbourne (Victoria), to Low Heads (Tasmania) (No. 1)	1869	1	180	180
Flinders, near Melbourne (Victoria), to Low Heads (Tasmania) (No. 2)	1885	1	179	179
Botany Bay, near Sydney (New South Wales), to Blind Bay, near Nelson (New Zealand) (No. 1)	1874	1	1,284	1,284
Sydney to Nelson (New Zealand) (No. 2)	1890	1	1,322	1,322
	25	25	16,132	16,132

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LANDING PLACES.	Date of Laying and No. of Cables.	No. of Conductors.	Length in Nautical Miles. Of Cables.	Of Conductors.
X.—EUROPE AND AZORES TELEGRAPH COMPANY.				
Head Office, Winchester House, Old Broad-street, London, E.C.				
Carcavellos (Lisbon) to Ponta Delgada (San Miguel, Azores)	1893	1	872·89	872·89
Ponta Delgada to Horta (Fayal, Azores)	1893	1	180·19	180·19
	2	2	1,053·08	1,053·08
XI.—ANGLO-AMERICAN TELEGRAPH COMPANY.				
Head Office, 26, Old Broad-street, London, E.C.				
1st. Transatlantic System.				
Valentia (Ireland) to Heart's Content (Newfoundland)	1873	1	1,881·29	1,881·29
Valentia (Ireland) to Heart's Content (Newfoundland)	1874	1	1,846·13	1,846·13
Valentia (Ireland) to Heart's Content (Newfoundland)	1880	1	1,890·49	1,890·49
Minou, near Brest (France), to St. Pierre	1869	1	2,717·62	2,717·62
2nd. European Communication.				
Salcombe (England) to Brignogan (France)	1870	1	101·00	101·00
3rd. Communication on American Coasts.				
Heart's Content to Placentia (Newfoundland)	1873	1	61·80	61·80
Heart's Content to Placentia (Newfoundland)	1880	1	61·26	61·26
New Brunswick to Prince Edward's Isle	1856	1	12·00	12·00
Placentia to St. Pierre	1880	3	111·96	335·88
St. Pierre to Sydney (Cape Breton)	1880	3	187·11	561·33
Placentia to Sydney	1873	1	320·63	320·63
Placentia to Sydney	1873	1	283·47	283·47
St. Pierre to Duxbury, near Boston (Massachusetts)	1869	1	808·69	808·69
Sydney (Cape Breton) to Canzo (Nova Scotia)	1891	1	116·55	116·55
	14	18	10,400·00	10,998·14
XII.—DIRECT UNITED STATES CABLE COMPANY.				
Head Office, Winchester House, Old Broad-street, London, E.C.				
Ballinskellig's Bay (Ireland) to Halifax	'74-'75	1	2,564·03	2,564·03
Halifax to Rye Beach (New Hampshire, U.S.)	1875	1	535·49	535·49
	2	2	3,099·52	3,099·52
XIII.—COMPAGNIE FRANÇAISE DU TÉLÉGRAPHE DE PARIS À NEW YORK.				
Head Office, 53 bis, Rue de Chateaudun, Paris.				
Brest (France) to St. Pierre	1879	1	2,281·65	2,281·65
St. Pierre to Cape Cod (Massachusetts)	1879	1	828·00	828·00
St. Pierre to Canzo (Nova Scotia)	1879	1	233·00	233·00
Déolin, near Brest (France), to Porcella Cove (Cornwall)	1880	1	153·20	153·20
	4	4	3,495·85	3,495·85
XIV.—WESTERN UNION TELEGRAPH COMPANY.				
Head Office, 195, Broadway, New York.				
London Agency, 252, Gresham House, Old Broad-street, E.C.				
1st. Transatlantic System.				
Sennen Cove, near Penzance, to Dover Bay, near Canzo (Nova Scotia), Northern cable	1881	1	2,581	2,581
Sennen Cove, near Penzance, to Dover Bay, near Canzo, Southern cable	1882	1	2,576	2,576
Dover Bay, near Canzo, to New York	1889	1	888	888
Dover Bay, near Canzo, to New York	1889	1	888	888
2nd. Gulf of Mexico System.				
Punta-Rassa (Florida) to Havana (Cuba), comprising the sections: I. Punta-Rassa to Key West ... II. Key West to Havana	1868	1	215	215
Carried forward	5	5	7,098	7,098

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LANDING PLACES.	Date of Laying and No. of Cables	No. of Conductors.	Length in Nautical Miles. Of Cables.	Of Conductors.
Brought forward	5	5	7,098	7,098
I. Punta-Rassa to Key West II. Key West to Havana	1873	1	215	215
I. Punta-Rassa to Key West II. Key West to Havana	1890	1	215	215
I. Punta-Rassa to Key West II. Key West to Havana	1890	1	215	215
	12	12	7,743	7,743
XV.—THE COMMERCIAL CABLE COMPANY.				
1, Broadway, New York; 11, Rue d'Alger, Paris; 23, Royal Exchange, London, E.C.				
1st. Communication in Europe.				
Havre to Waterville (Ireland)	1885	1	510·15	510·15
Waterville to Weston-super-Mare (near Bristol)	1885	2	328·88	657·76
2nd. Transatlantic System.				
Waterville (Ireland) to Canso (Nova Scotia)	1884	1	2,350·36	2,350·36
Waterville (Ireland) to Canso (Nova Scotia)	1884	1	2,388·35	2,388·35
3rd. Communications on the American Coast.				
Canso (Nova Scotia) to New York	1884	1	840·93	840·93
Canso to Rockport (near Boston)	1885	2	518·94	1·037·88
	6	8	6,937·61	7,785·43
XVI.—BRAZILIAN SUBMARINE TELEGRAPH COMPANY.				
Head Office, Winchester House, Old Broad-street, London, E.C.				
Carcavellos, near Lisbon (Portugal), to Madeira	1874	1	632·430	632·430
Carcavellos, near Lisbon (Portugal), to Madeira	1882	1	627·530	627·530
Madeira to St. Vincent (Cape Verde Island)	1874	1	1,210·947	1,210·947
Madeira to St. Vincent (Cape Verde Island)	1884	1	1,169·440	1,169·440
St. Vincent to Pernambuco (Brazil)	1874	1	1,873·994	1,873·994
St. Vincent to Pernambuco (Brazil)	1884	1	1,862·318	1,862·318
	6	6	7,376·659	7,376·659
XVII.—AFRICAN DIRECT TELEGRAPH COMPANY.				
Head Office, Winchester House, Old Broad-street, London, E.C.				
St. Vincent to Santiago (Cape Verde Islands)	1884	1	194	194
Santiago to Bathurst (British possession)	1886	1	471	471
Bathurst to Sierra Leone	1886	1	463	463
Sierra Leone to Accra	1886	1	1,020	1,020
Accra to Lagos	1886	1	261	261
Lagos to Brass	1886	1	269	269
Brass to Bonny	1886	1	68	68
	7	7	2,746	2,746
XVIII.—CUBA SUBMARINE TELEGRAPH COMPANY, LIMITED.				
Head Office, 58, Old Broad-street, London, E.C.				
Batabano (Cuba) to Cienfuegos (Cuba)	1870	1	120	120
Batabano (Cuba) to Cienfuegos (Cuba)	1891	1	140	140
Cienfuegos to Santiago (Cuba)	1875	1	420	420
Cienfuegos to Santiago (Cuba)	1881	1	420	420
	4	4	1,100	1,100
XIX.—WEST INDIA AND PANAMA TELEGRAPH COMPANY.				
Head Office, Dashwood House, 9, New Broad-st., London, E.C.				
Santiago (Cuba) to Holland Bay (Jamaica)	1870	1	160	160
Santiago (Cuba) to Holland Bay (Jamaica)	1878	1	146	146
Kingston (Jamaica) to Colon (Isthmus of Panama)	1870	1	630	630
Carried forward	3	3	936	936

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LANDING PLACES.	Date of Laying and No. of Cables	No. of Conductors.	Length in Nautical Miles. Of Cables.	Of Conductors.
Brought forward	3	3	936	936
Holland Bay to St. Juan (Porto Rico)	1870	1	683	683
St. Juan to St. Thomas	1871	1	72	72
Holland Bay to Ponce (Porto Rico)	1874	1	647	647
Ponce to St. Croix	1875	1	135	135
St. Croix to St. Thomas	1875	1	48	48
St. Thomas to St. Kitts	1871	1	161	161
St. Kitts to Antigua	1871	1	49	49
Antigua to Basse-Terre (Guadaloupe)	1871	1	73	73
Basse-Terre to Dominica	1871	1	51	51
Dominica to Martinique	1871	1	40	40
Martinique to St. Lucia	1871	1	55	55
St. Lucia to St. Vincent	1871	1	58	58
St. Vincent to Barbadoes	1871	1	99	99
St. Vincent to Barbadoes	1890	1	94	94
St. Vincent to Grenada	1871	1	84	84
Grenada to Trinidad	1871	1	89	89
St. Croix to Port of Spain (Trinidad)	1875	1	541	541
Trinidad to Demerara (English Guiana)	1871	1	298	298
Trinidad to Demerara, No. 2	1891	1	344	344
	22	22	4,557	4,557
XX. — SOCIETÉ FRANÇAISE DES TÉLÉGRAPHES SOUS-MARINS.				
Head Office, 32, Rue Caumartin, Paris.				
West Indies System.				
Castillo de Aguadores (Cuba) to Guantanamo (Cuba)	1888	1	50·65	50·65
Guantanamo (Cuba) to Môle-St.-Nicolas (Hayti)	1888	1	126·76	126·76
Môle-St.-Nicolas (Hayti) to Cap Haitien (Hayti)	1888-91	1	96·04	96·04
Cap Haitien (Hayti) to Puerto-Plata (San Domingo)	1888-91	1	117·83	117·83
Puerto-Plata (San Domingo) to Fort de France (Martinique)	1891	1	787·42	787·42
Fort de France (Martinique) to Paramaribo (Dutch Guyana)	1890	1	777·23	777·23
Paramaribo (Dutch Guyana) to Cayenne (French Guyana)	1891	1	257·53	257·53
Cayenne (French Guyana) to Vizeu (Brazil)	1891	1	662·32	662·32
Môle-St.-Nicolas (Hayti) to Port-au-Prince (Hayti)	1890	1	124·76	124·76
San Domingo to Curaçao	1888	1	453·47	453·47
Curaçao to La Guayra (Venezuela)	1888	1	163·37	163·37
Fort de France (Martinique) to St. Pierre (Martinique)	1891	1	14·86	14·86
L'Anse Belleville (Martinique) to Gozier (Guadeloupe)	1889-90	1	101·99	101·99
Gozier (Guadeloupe) to St. Louis (Marie Galante Island)	1889-90	1	19·81	19·81
Australian Cable.				
Bundaberg (Queensland) to Gomen (New Caledonia)	1893	1	864·00	864·00
	15	15	4,618·04	4,618·04
XXI.—WESTERN AND BRAZILIAN TELEGRAPH COMPANY.				
Head Office, 19, Great Winchester-street, London, E.C.				
Para (Brazil) to Maranham (Brazil)	1873	1	381	381
Maranham to Ceara (Brazil)	1873	1	406	406
Ceara to Pernambuco (Brazil)	1873	1	476	476
Pernambuco to Bahia (No. 1 section)	1873	1	396	396
Pernambuco to Bahia (No. 2 ,,)	1891	1	428	428
Bahia to Rio de Janeiro (No. 1 section)	1873	1	839	839
Bahia to Rio de Janeiro (No. 2 ,,)	1891	1	768	768
Rio de Janeiro to Santos (No. 1 section)	1874	1	230	230
Rio de Janeiro to Santos (No. 2 ,,)	1891	1	223	223
Santos to St. Catherina (Brazil)	1874	1	292	292
Santos to Chuy (No. 2 section)	1892	1	742	742
St. Catherina to Rio Grande do Sul (Brazil)	1874	1	394	394
Rio Grande do Sul to Chuy (Uruguay)	1875	1	148	148
Chuy to Montevideo (Uruguay) (No. 1 section)	1889	1	202	202
Chuy to Maldonado (Uruguay) (No. 2 ,,)	1875	1	126	126
Maldonado to Montevideo (Uruguay)	1875	1	76	76
	16	16	864·00	864·00

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LANDING PLACES.	Date of Laying and No. of Cables	No. of Conductors.	Length in Nautical Miles. Of Cables.	Of Conductors.
XXII.—RIVER PLATE TELEGRAPH COMPANY.				
Head Office, Montevideo.				
Montevideo to Colonia	1873	1	90	90
Colonia to Punta Lara (Argentine Republic)	1866	3	24	72
,, ,, ,,	1888	1	24	24
	3	5	138	186
XXIII.—MEXICAN TELEGRAPH COMPANY.				
Head Office, 37 and 39, Wall-street, New York.				
Galveston (Texas) to Tampico (Mexico)	1882	1	484	484
Tampico to Vera Cruz (Mexico)	1880	1	220	220
Galveston (Texas) to Coazacoalcos (Mexico)	1889	1	825	825
	3	3	1,529	1,529
XXIV.—CENTRAL AND SOUTH AMERICAN TELEGRAPH COMPANY.				
Head Office, 37 and 39, Wall-street, New York.				
1st Atlantic System.				
Vera Cruz (Mexico) to Goatzacoalcos (Mexico)	1881	1	129·50	129·50
2nd Pacific System.				
Salina Cruz (Mexico) to Libertad (Salvador)	1882	1	434·50	434·50
Libertad to San Juan del Sur (Nicaragua)	1882	1	269·84	269·84
San Juan del Sur to Panama	1882	1	721	721
Panama to Buenaventura (Colombia)	1882	1	394	394
Buenaventura to St. Elena (Equator)	1882	1	501	501
St. Elena to Payta (Peru)	1882	1	240	240
Payta to Chorillos, near Callao-Lima (Peru)	1882	1	553	553
Chorillos (Peru) to Iquique (Chili)	1891	1	747	747
Iquique to Valparaiso (Chili)	1891	1	877	877
Salina Cruz (Mexico) to San Juan	—	1	690	690
San Juan to St. Elena	—	1	1,034	1,034
St. Elena to Chorillos	—	1	800	800
(Land line Valparaiso to Buenos Ayres, Arg., 1,200 miles.)				
	13	13	7,390·84	7,390·84
XXV.—WEST COAST OF AMERICA TELEGRAPH COMPANY.				
Head Office, 120, Cannon-street, London, E.C.				
Chorillos, near Lima (Peru) to Mollendo (Peru)	1875	1	510·08	510·08
Mollendo to Arica (Peru)	1875	1	146·42	146·42
Arica to Iquique (Peru)	1875	1	128·35	128·35
Iquique to Antofagasta (Chili)	1885	1	250·50	250·50
Antofagasta to Caldera (Chili)	1875	1	229	229
Caldera to Serena, near Coquimbo (Chili)	1876	1	215·34	215·34
Serena to Valparaiso (Chili)	1876	1	219·03	219·03
Valparaiso to Talcahuano (Chili), near Concepcion (Chili)	1893	1	267·20	267·20
	8	8	1,965·92	1,965·92
XXVI.—CANADIAN PACIFIC RAILROAD COMPANY.				
Saanich Arm to British Columbia	1881	1	2·0	2·0
Vancouver Island to Gabriola Island (British Columbia)	1881	1	1·0	1·0
Valdes Island to Port Grey (British Columbia)	1881	1	21·30	21·30
Fraser River crossings (two cables)	1881	1	1·0	1·0
Vancouver Island to Washington State (U.S.)	1884	1	17·0	17·0
	5	5	42·30	42·30
XXVII.—SOUTH AMERICAN CABLE CO., Ltd.				
Head Office, 106, Cannon-street, London, E.C.				
St. Louis du Senegal to Fernando Noronha	1892	1	1,728·669	1,728·669
Fernando Noronha to Pernambuco	1892	1	346·84	346·84
	2	2	2,075·509	2,075·509

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THE WORLD'S CABLE FLEET.

	Steamer.	Gross Tonnage.	Effective H.P.	Submarine Superintendent.	Navigating Commander.	Station.
British Government	Monarch	1,121	1,040	D. Lumsden	F. Alford	Woolwich.
British Government	The Lady Carmichael	369	350	W. R. Culley	J. Wrake	Dover.

Company, &c.	Steamer.	Gross Tonnage.	H.P. Nominal.	Captain.	Chief Electrician.	Usual Station.
Anglo-American	Minia	1,986	250	S. Trott	Maynard Dodd	Halifax, N.S.
Canadian Government	Newfield	785	90	J. H. Campbell	—	Halifax, N.S.
Central and South American	Relay	1,200	180	W. R. Lugar	H. Kingsford	Callao.
Commercial Cable	Mackay-Bennett	1,718	300	E. G. Schenk	C. Priest	Halifax, N.S.
Cie. Franç. du Télégraphe de Paris à N. York	Pouyer-Quertier	1,385	160	— Touan	—	Brest.
Chinese (Formosa) Government	Fee Cheu	1,034	150	Len Ven-ho	E. Hansen	Formosa.
Eastern	Amber	978	160	R. Greey	W. Murphy	Aden.
Eastern	Electra	1,000	200	H. Scott-Smith	H. Wansell	Malta.
Eastern	John Pender	1,213	98	W. Perkins	F. Ryan	London.
Eastern	Mirror	1,500	250	G. Pattison	J. Boyes	Gibraltar.
Eastern	Chiltern	1,304	200	J. W. Starkey	F. Lilley	London.
Eastern and South African	Great Northern	1,352	130	V. Fox	C. Shaw	Cape Town.
Eastern Extension	Recorder	1,201	250	R. A. E. Brereton	A. C. M. Weaver	Singapore.
Eastern Extension	Sherard Osborn	1,429	900	C. O. Madge	J. H. D. Jones	Singapore.
French Government	Ampère	304,753	70	—	—	Brest.
French Government	Charente	547,824	120	—	—	La Seyne.
Great Northern	H. C. Oersted	749	120	G. Oersted	C. E. Koefod	Copenhagen.
Great Northern	Store Nordiske	832	120	Einar Suenson	W. J. Schönau	Shanghai.
India Rubber Company (Silvertown)	Buccaneer	785	180	D. Morton	—	Silvertown.
India Rubber Company (Silvertown)	Dacia	1,856	170	—	—	Silvertown.
India Rubber Company (Silvertown)	International	1,381	110	—	—	Silvertown.
India Rubber Company (Silvertown)	Silvertown	4,935	400	A.S.Thomson, R.N.R.	—	Silvertown.
Indian Government	Patrick Stewart	1,115	130	W. A. Tindall	—	Karachi.
Pirelli and Co.	Città di Milano	1,220	220	—	—	Spezia.
Siemens Bros. and Co.	Faraday	4,917	500	P. Le Fanu	—	London.
Société Générale des Téléphones	François Arago	3,191	300	H. Offret	—	Calais.
Telegraph Construction and Maintenance	Britannia	1,525	200	J. Kennedy, R.N.R.	—	London.
Telegraph Construction and Maintenance	Calabria	3,321	220	H. Woodcock	—	London.
Telegraph Construction and Maintenance	Scotia	4,667	550	W. R. Cato, R.N.R.	—	London.
Telegraph Construction and Maintenance	Seine	3,553	500	J. Seymour	—	London.
Western and Brazilian	Norseman (No. 2)	1,117	287	W. H. Lacy	E. C. Cummins	Rio Janeiro.
Western and Brazilian	Norseman (No. 1)	1,372	200	—	—	Out of commission.
Western and Brazilian	Viking	436	60	—	—	Out of commission.
West Coast of America	Retriever	624	95	W. B. Minhinnick.	—	Callao.
West India and Panama	Duchess of Marlborough	402	80	J. Farrier	J. W. Hintze	West Indies.
West India and Panama	Grappler	868	100	J. W. Dickinson	A. C. O'Bryen	West Indies.

Governments and Contractors usually appoint Electricians to their ships as occasion arises.

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THE NATIONAL TELEPHONE COMPANY, LIMITED.

HEAD OFFICE: OXFORD COURT, CANNON STREET, LONDON, E.C.

LIST OF CENTRES, SUB-CENTRES, SUB-EXCHANGES, AND NUMBER OF LINES,

AS AT 31ST OCTOBER, 1893.

Total Number of Exchanges	540	Number of Exchange Lines	53,784
Total Number of Call Offices	1,283	Number of Private Lines	10,257

Total Number of Lines..... 64,041.

	CENTRE.	No. of Exchanges.
PROVINCE OF SCOTLAND.	London	30
	Glasgow and Bearsden	6
	Edinburgh, Leith, Granton, Portobello, Musselburgh, Dalkeith, Lasswade, Loanhead, Gorebridge, Penicuik, Bathgate and Broxburn	15
	Dundee, Western, Bro. Ferry, Newport, Downfield, Monifieth, Carnoustie, Forfar, and Brechin	9
	Perth	1
	Arbroath	1
	Montrose	1
	Aberdeen, Cults, and Woodside	3
	Greenock, Rothesay, Craigmore, Port Bannatyne, Largs, and Shelmorlie	6
	Paisley, Johnstone, Barrhead and Renfrew	4
	Galashiels, Selkirk, Melrose, Clovenfords, Walkerburn, Innerleithen, Peebles, St. Boswells, Kelso, and Hawick	10
	Kirkcaldy, Leven, Markinch, Kinghorn, Burntisland, Dunfermline, Cowdenbeath, Cupar, St. Andrew's, Stirling, Bridge of Allan, Alloa, Dunblane, and Tillicoultry	14
	Kilmarnock, Ayr, Irvine, Ardrossan, Troon, Beith, and Catrine	7
	Hamilton, Coatbridge, Airdrie, Bothwell, Motherwell, Wishaw, and Uddingston	7
	Dumbarton, Alexandria, Helensburgh, and Row	4
	Falkirk, Grangemouth, Bo'ness, Linlithgow, and Kirkintilloch	5
	Dumfries, Glencaple, Collin, Annan, Carrutherstown, Clarencefield, Gretna, Langholm, Auldgirth, Thornhill, and Sanquhar	11
	Inverness, Beauly, Muir-of-Ord, Dingwall, and Strathpeffer	5
	Oban	1
NORTHERN PROVINCE.	Newcastle-on-Tyne, Gateshead, Blaydon, Blyth, Morpeth, Hexham, Corbridge, Alnwick, Alnmouth, Berwick, and Wallsend	16
	Sunderland, Seaham, Ryhope, Hylton, Houghton-le-Spring, South Shields, Jarrow, North Shields, Tynemouth, and Whitley	11
	Middlesbro', Stockton, Linthorpe, Saltburn, Redcar, Eaglescliffe, Norton, and Yarm	8
	West Hartlepool, East Hartlepool, and Seaton Carew	3
NORTHERN PROVINCE.	Durham, Darlington, Bishop Auckland, Consett, Chester-le-Street, Shotley Bridge, and Leadgate	7
	Hull	
	York	
	Scarboro'	
	Grimsby	
	Goole	
	Leeds, Headingley, Stanningley, Chapeltown, Morley, and Roundhay	6
	Dewsbury, Batley, Cleckheaton, Ossett, Birstall, Mirfield, and Heckmondwike	7
	Wakefield, Castleford, and Pontefract.	3
	Harrogate, Otley, and Ripon	3
	Bradford, Manningham, Shipley, Bingley, Keighley, Haworth, Steeton, Skipton, Lowmoor, Thornton, Dudley Hill, Idle, Rawdon, and Ilkley	14
	Huddersfield, Brighouse, Holmfirth, Milnsbridge, Skelmanthorpe, and Elland	6
	Halifax, Hebden Bridge, Sowerby Bridge, Lightcliffe, and Luddendenfoot	5
NORTH WESTERN PROVINCE.	Liverpool, Bootle, Sefton Park, Waterloo, Lark Lane, Garston, Wavertree, Toxteth Park, Gateacre, Old Swan, Anfield, Walton, West Derby, Huyton, Birkenhead, Liscard, Rock Ferry, West Kirby, Bromboro', and Neston	20
	Manchester, Altrincham, Cheetham Hill, Didsbury, Higher Broughton, Openshaw, Rusholme, and Sale	8
	Blackburn, Accrington, Darwen, Chorley, Great Harwood, Clitheroe, Wilpshire, Ribchester, and Longridge	9
	Burnley, Nelson, Padiham, and Todmorden	4
	Preston, Ashton, Fulwood, and Bamber Bridge	4
	Lancaster, Morecambe, and Caton	3
	Blackpool, Lytham, Fleetwood, and St. Anne's	4
	Bacup and Haslingden	2
	Oldham, Shaw, and Middleton	3
	Ashton, Hyde, and Glossop	3
	Stockport, Denton, Macclesfield, and Bollington	4
	Bolton, Atherton, Farnworth, Horwich, and Leigh	5

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THE NATIONAL TELEPHONE COMPANY, LIMITED—(*Continued.*)

	CENTRE.	No. of Exchanges.
NORTH WESTERN PROVINCE.	Bury, Radcliffe, and Ramsbottom	3
	Rochdale, Heywood, and Littleborough	3
	Warrington, Widnes, and Runcorn	3
	Wigan, St. Helen's, Prescot, Ashton, and Newton	5
	Southport, Ormskirk, and Skelmersdale	3
	Whitehaven, Cleator Moor, Frizington, St. Bees, Harrington, Workington, Cockermouth, Maryport, Aspatria, Wigton, Dalston, Carlisle, Barrow, and Ulverston	14
	Chester, Llandudno, Colwyn Bay, Northwich, Middlewich, Shrewsbury, Wrexham, and Ruabon	8
	Douglas	1
MIDLAND PROVINCE.	Birmingham, Jewellers, Edgbaston, Moseley, Aston, Selly Oak, West Bromwich, Oldbury, Smethwick	9
	Wolverhampton, Bilston, Dudley, Lye and Tipton	5
	Wednesbury, Walsall, and Darlaston	3
	Coventry, Warwick, and Leamington	3
	Kidderminster	1
	Worcester	1
	Hanley, Burslem, Longton, Tunstall, Newcastle, Stoke, Leek, Stafford, and Stone	9
	Derby, Belper, Duffield, and Burton-on-Trent	4
	Nottingham, Basford, Ilkeston, Long Eaton, Carrington, Loughboro', and Mansfield	7
	Leicester, Wigston, and Hinckley	3
	Northampton, Wellingboro', Kettering, and Rushden	4
	Lincoln and Gainsboro'	2
	Sheffield, Rotherham, Mexboro, Ecclesfield, Dronfield, Eckington, Beauchief, Wortley, Stocksbridge, Oughtibridge, Chesterfield, Baslow, Bakewell, Doncaster, Penistone, Barnsley, and Worksop	17
SOUTHERN PROVINCE.	Cambridge, Watford, and Haverhill	3
	King's Lynn and Peterborough	2
	Norwich and Yarmouth	2
	Ipswich	1
	Reading and Maidenhead	2
	Oxford	1
	Brighton, Hurstpierpoint, Lewes, Newhaven, Rottingdean, Shoreham, Steyning, and Worthing	11
	Eastbourne	1
SOUTHERN PROVINCE.	Hastings	2
	Canterbury, Ashford, Chartham, Faversham, Boughton, and Whitstable	6
	Margate, Westgate, Ramsgate, Minster, and Broadstairs	5
	Deal and Sandwich	2
	Dover, Folkestone, Sandgate, and Hythe	4
	Tunbridge Wells, Southborough, and Tonbridge	3
	Chatham and Maidstone	2
	Bournemouth, Boscombe, Poole, and Christchurch	4
	Portsmouth, Southsea, and Gosport	3
	Southampton and Winchester	2
	Weymouth	1
	Plymouth, Devonport, Mutley, Crown Hill, Plympton, Cawsand, Millbrook, and Ivybridge	8
	Torquay, Paignton, Brixham, Dartmouth, Totnes, Buckfastleigh, Ashburton, Teignmouth, Dawlish, and Newton	10
	Exeter	1
	Cardiff, Penarth, Barry Dock, Pontypridd, Aberdare, Merthyr, and Tredegar	8
	Swansea, Port Talbot, Briton Ferry, Neath, Llanelly, Mumbles, and Morriston	7
	Newport, Pontypool, and Lydney	3
	Bristol, Clifton, Kingswood, and Weston-Super-Mare	4
	Bath and Swindon	2
	Cheltenham and Tewkesbury	2
	Gloucester, Churchdown, and Sharpness	3
	ULSTER.	
	Belfast, Bangor, Carrickfergus, Comber, Lisburn, Larne, Lurgan, Newtownards, Portadown, Whitehouse, Whiteabbey, and Doagh	12
	Londonderry and Strabane	2
	DUBLIN AND SOUTH OF IRELAND.	
	Dublin, Rathmines, Kingstown, Drogheda, and Dundalk	6
	Cork, Queenstown, and Midleton	3
	Limerick	1
	Total	540

W. E. L. GAINE, *General Manager.*

NEW TELEPHONE COMPANY, LIMITED.

Head Office:—TELEPHONE EXCHANGE, LONDON WALL, LONDON, E.C.

List of Centres.	Exchange Lines.	Private Lines.	Call Offices.	Trunk Lines.	List of Centres.	Exchange Lines.	Private Lines.	Call Offices.	Trunk Lines.
Manchester	1,355	138	6	3	Liverpool	—	37	—	—
Pendleton	17	—	1	—	London	—	1	—	—
Eccles	27	—	1	—					
Bolton	86	30	3	3					
Radcliffe	7	—	1	—	Total	1,492	206	12	6

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BRITISH GOVERNMENT DEPARTMENTS,

AND THE CHIEF OFFICIALS CONNECTED WITH ELECTRICITY, ENGINEERING, &C.

HOME OFFICE,

WHITEHALL, S.W.

Principal Secretary of State for Home Affairs.—Right Hon. H. H. Asquith, Q.C., M.P.
Permanent Under-Secretary.—Sir Godfrey Lushington, K.C.B.
Parliamentary Under-Secretary.—Herbert J. Gladstone, M.P.
Legal Under-Secretary.—Edward Leigh Pemberton.
Inspectors of Explosives.—Col. Vivian D. Majendie, C.B. (Chief); Col. Arthur Ford and Capt. J. H. Thomson, R.A.
Chemical Adviser.—Dr. Dupré, F.R.S.
Inspectors of Mines.—F. N. Wardell, Wath, Rotherham; Thomas Bell, Shamrock House, Durham; H. Hall, Rainhill, Prescot; W. B. Scott, Great Barr, Birmingham; J. M. Ronaldson, 44, Athole Gardens, Glasgow; J. S. Martin, Durdham Park, Bristol; J. T. Robson, Swansea; A. H. Stokes, Greenhill, Derby; J. B. Atkinson, 10, Foremount-terrace, Glasgow; W. N. Atkinson, Newcastle-under-Lyme; J. L. Hedley, Newcastle-upon-Tyne; John Gerrard, Worsley, Manchester.
Inspector of Metalliferous Mines.—C. Le Neve Foster, Llandudno.
Assistant Inspectors of Mines.—R. D. Bain, Clifton, Bristol; W. H. Pickering, Wolverhampton; R. P. W. Oswald, Hensingham, Whitehaven; R. MacLaren, Uddingston, N.B.; W. H. Hepplewhite, 15, Corporation Oaks, Nottingham; Jas. Mellors, Outwood, near Wakefield; J. Plummer, Bishop Auckland; G F. Bell, Newcastle-on-Tyne; F. A. Gray, Neath; Hugh Johnstone, 2, Boswell-terrace, Kelvinside, Glasgow; W. Saint, Manchester; W. Walker, 9, Victoria-terrace, Durham; T. H. Mottram, Glasgow; H. R. Makepeace, Newcastle-under-Lyme; E. E. V. Stokes, Truro; H. R. Hewitt, 47, Hartington-street, Derby; J. M. Sims, Roath, Cardiff; J. Dyer Lewis, Swansea; Andrew Pearson, Glasgow; D. H. F. Mathews, Newton-le-Willows, Lancs.; J. R. R. Wilson, Leeds; G. B. Harrison.

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Permanent Secretary.—Sir Courtenay Boyle, K.C.B.
Parliamentary Secretary.—Thomas Burt, M.P.
Comptroller-General of Commercial, Labour and Statistical Department.—Robert Giffen, LL.D., C.B.
Assistant Secretaries. — *Harbour Department*, C. Cecil Trevor, C.B.; *Fisheries Department*, A. D. Berrington; *Marine Department*, Ingram B. Walker; *Railway Department*, Francis J. S. Hopwood, C.M.G.; *Finance Department*, Cosmo Monkhouse.
Inspectors of Railways.—Major-Gen. C. S. Hutchinson, C.B., R.E.; Major F. A. Marindin, C.M.G., R.E.; Major H. A. Yorke, R.E.
Electric Adviser.—Major P. Cardew, R.E.
Electrician.—J. Rennie.
Superintendent of Standards Department.—H. J. Chaney.

OFFICERS APPOINTED UNDER METROPOLITAN GAS ACTS.

Referees.—Dr. W. Pole, F.R.S.; A. G. Vernon-Harcourt, F.R.S.; and Prof. Rücker, F.R.S.
Chief Gas Examiner.—Dr. Alexander William Williamson, F.R.S.

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WHITEHALL, S.W.

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Permanent Secretary.—Sir Hugh Owen, K.C.B.
Chief Engineering Inspector.—Major Hector Tulloch, R.E.
Deputy do. do. —Arnold Taylor.
Engineering Inspectors.—T. Codrington, C.E.; Major-Gen. C. Phipps Carey, R.E.; Col. W. M. Ducat, R.E.; Col. C. H. Luard, R.E.; Col. J. O. Hosted, R.E.; Major-Gen. H. D. Crozier, R.E., and Rienzi Walton, C.E.

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12, WHITEHALL PLACE, S.W.

First Commissioner.—Right Hon. George John Shaw Lefevre, M.P.
Secretary.—H. W. Primrose, C.S.I.
Principal Clerks.—J. Willis and H. R. Potter.
Private Secretaries to First Commissioner.—H. J. Hapgood and Hon. G. Hamilton Gordon.
Surveyors, First Class.—J. Taylor, R. H. Boyce, W. W. Robertson, and H. Tanner.
Resident Engineer, Houses of Parliament.—W. J. Prim.

DEPARTMENT OF SCIENCE AND ART,

CROMWELL ROAD, SOUTH KENSINGTON, S.W.

Lord President of the Council.—Right Hon. Earl of Kimberley, K.G.
Vice-President of the Committee of Council on Education.—Right Hon. Arthur H. D. Acland, M.P.
Secretary.—Major-Gen. Sir John F. D. Donnelly, K.C.B. (late R.E.).
Assistant Secretary.—G. Francis Duncombe.
Director of Science Division.—Captain W. de W. Abney, C.B., D.C.L., F.R.S. (late R.E.).
Assistant Director of Science Division.—Frank Rede Fowke.
Official Examiner (Science Division).—T. Healey.
Assistant Examiners (Science Division).—C. McRae, M.A., and O. J. Dullea.
Inspectors of Science and Art Schools.—R. G. Wylde, F. B. Barwell, C. A. Buckmaster, M.A., and G. R. Redgrave.
Occasional Inspectors for Science.—J. Norman Lockyer, C.B., F.R.S., and C. McRae, M.A.
Organising Master of Science and Art Classes.—J. C. Buckmaster, F.C.S.
(For Professors, &c., in the Royal College of Science, *see* p. 271.)

SOUTH KENSINGTON MUSEUM AND BRANCH MUSEUM AT BETHNAL GREEN.

Director (Science Museum).—Major-Gen. E. R. Festing, F.R.S. (late R.E.).
Director (Art Museum).—J. H. Middleton, Litt.D., D.C.L., F.S.A.
Assistant Director.—C. Purdon Clarke, C.I.E.
Museum Keepers.—A. C. King, F.S.A., W. J. Last, W. H. J. Weale, A. B. Skinner, B.A., H. M. Cundall, F.S.A., H. E. Acton, C. H. Derby, B.A. (*Resident Officer in charge of Bethnal Green Branch Museum*).

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DUBLIN MUSEUM OF SCIENCE AND ART.

Director.—V. Ball, C.B., LL.D., F.R.S.
Chief Clerk.—H. Bantry White, M.A., M.E.
Keeper Art and Industrial Department.—T. H. Longfield, F.S.A.
Curator Royal Irish Academy Collections.—Major McEniry.
Assistants.—J. J. Buckley and E. P. Alabaster.
Technical Assistant.—A. McGoogan.
Keeper Natural History Department.—R. F. Scharff, Ph.D., B.Sc.

ADMIRALTY,

WHITEHALL, S.W.

First Lord.—Right Hon. Earl Spencer, K.G.
Parliamentary Secretary.—Right Hon. Sir U. J. Kay-Shuttleworth, Bart., M.P.
Permanent Secretary.—Sir Evan MacGregor, K.C.B.
Engineer-in-Chief.—Albert J. Durston.
Inspector of Machinery.—R. J. Butler.
Director of Dockyards.—J. Williamson.
Engineer Assistant to Director of Dockyards.—Alfred Wood.
Assistant Secretary.—Robert Davis Awdry.
Director of Navy Contracts.—John Collett.
Assistant Director.—Tatham Gwyn.

WAR OFFICE,

PALL MALL, S.W.

Secretary of State for War.—Right Hon. H. Campbell-Bannerman, M.P.
Parliamentary Secretary.—Lord Sandhurst.
Permanent Secretary.—Sir Ralph W. Thompson, K.C.B.
Director of Contracts.—G. Lawson, C.B. *Assistant.*—William J. Stacey.
President of Royal Engineer Committee.—Major-Gen. E. O. Hewett, C.M.G., R.E.
Secretary.—Capt. Herbert Edward Rawson, R.E.
Director-General of Ordnance Factories.—W. Anderson, C.E., D.C.L.

INDIA OFFICE,

ST. JAMES'S PARK, S.W.

Principal Secretary of State.—Right Hon. Earl of Kimberley, K.G.
Permanent Under Secretary.—Sir Arthur Godley, K.C.B.
Parliamentary Under Secretary.—G. W. E. Russell, M.P.
Assistant Under Secretary.—Sir Horace G. Walpole, K.C.B.
Public Works Secretary.—Clement S. Colvin.
Consulting Engineer.—Sir Alexander M. Rendel, K.C.I.E.
Director-General of Stores.—Joseph Parker.
Superintendent Branch Department (Belvedere-road, Lambeth).—Lt.-Col. D. O'Brien, R.E.
Assistant do. do. —Major D. C. Courtney, R.E.
Inspector Scientific Instruments.—Thomas Cushing.
Director of Indo-European Telegraph Department.—B. T. Ffinch.

COLONIAL OFFICE,

DOWNING STREET, S.W.

Principal Secretary of State.—Right Hon. Marquis of Ripon, K.G.
Permanent Under-Secretary.—Hon. R. H. Meade, C.B.
Parliamentary Under Secretary.—Sydney Charles Buxton, M.P.

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CROWN AGENTS FOR THE COLONIES,

DOWNING STREET, S.W., and 1, TOKENHOUSE BUILDINGS, E.C.

Crown Agents.—Sir Montagu F. Ommanney, K.C.M.G., and Ernest Edward Blake.
Registrar.—T. Dunn.
Engineering Clerk and Head of Contract Branch.—T. R. Marsh, M.A.
Consulting Engineers.—Messrs. Gregory and Eyles, C.E., Messrs. Hawkshaw and Hayter, C.E. (*Railways*); Messrs. Coode, Son and Matthews, C.E., (*Harbour Works*); W. H. Preece, C.B., C.E. (*Telegraphs*); O. Chadwick, C.M.G., C.E. (*Water and Sanitary*).
Inspecting Engineers.—Henry Wakefield, C.E., and W. H. Stanger, C.E. (*General Works*); W. P. Marshall & Son, C.E (*Locomotives and Railway Carriages*); J. H. Greener, C.E. (*Telegraph Materials*).
Consulting Chemists, Analysts, and Assayers.—W. H. Stanger, F.C.S.: Bertram Blount, F.C.S.

ROYAL OBSERVATORY,

GREENWICH, S.E.

Astronomer Royal.—William Henry Mahoney Christie, M.A., F.R.S., F.R.A.S.
Chief Assistant. — Herbert Hall Turner, M.A., B.Sc., F.R.A.S. (resigns in March, 1894).
First-Class Assistants.—G. S. Criswick; W. C. Nash (Superintendent of Magnetic and Meteorological Department); T. Lewis; E. W. Maunder, F.R.A.S. (*Physical Assistant*); W. G. Thackeray.

TRINITY HOUSE,

TOWER HILL, E.C.

Master.—H.R.H. the Duke of Saxe-Coburg and Gotha (Duke of Edinburgh), K.G., K.T., K.P., &c.
Secretary.—Charles A. Kent.
Engineer.—Thomas Matthews, M.I.C.E.
Chief Engineering Clerk.—T. Williams.

THAMES CONSERVANCY,

41, TRINITY SQUARE, E.C.

Deputy Chairman.—Admiral Sir Fred. W. E. Nicolson, Bart., C.B.
Secretary.—James H. Gough.
Engineer.—Charles James More, C.E.
Solicitor.—James Hughes.

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LOCAL AUTHORITIES:

The Chief Officials of the County and Borough Councils and other Local Authorities in London and Great Britain.

The following Information has been compiled, in view of the interest now being taken by Municipal Bodies in the introduction of Electric Light and Power into the districts over which they have jurisdiction, and to assist Electric Light and Power Contractors, Electrical Supplies Makers, &c., to introduce their special manufactures to the notice of Public Officials all over the country.

LONDON.

NOTE.—For Local Boards in the Provinces, *see* pp. **240—251.**

Vestry or District Board of Works.	Clerk.	Lighting Engineer.	Surveyor.	Price of Gas. Prvte. Consmrs.	Price of Gas. Pub. Lamps.
BATTERSEA VESTRY, Battersea-rise, S.W.	W. Marcus Wilkins	.....	J. T. Pilditch	2/2, 2/6, 2/8	...
BERMONDSEY VESTRY, Town Hall, Spa-rd, S.E *C.89*	J. Harrison	.....	Frank Sumner.....	2/5	...
BETHNAL GREEN VESTRY, Church-row, E.	R. Voss.....	.....	F. W. Barratt	3/1	...
CHELSEA VESTRY, King's-rd, S.W. *C.86, 89*	Thomas Holland.....	.....	T. W. E. Higgins ...	3/1	...
CAMBERWELL VESTRY, Peckham-rd, S.E. ..... *C 90*	Charles Wm. Tagg	... ..	Ormond S. Brown ...	3/1	...
CLERKENWELL VESTRY, Rosoman-st, E.C. *C.89*	R. E. Paget	.....	Wm. Iron	3/1	2/2
COMMISSIONERS OF SEWERS, Guildhall, E.C. ..... *C 90, 91*	H. Blake	W. Haywood, C.E....	W. Haywood, C.E....	3/1	2/2
FULHAM VESTRY, Walham-green, W.	W. J. H. Denselow	.....	J.P. Norrington, C.E.	3/1	2/2
GREENWICH DISTRICT BOARD OF WORKS, Greenwich-rd, S.E.....*C 89*	J. Spencer	J. Nidd Smith	J. Nidd Smith	2/5	...
HACKNEY DISTRICT BOARD OF WORKS, Mare-st., E. *L.A.93*	(Vacant)	.....	Jas. Lovegrove	3/1	...
HAMMERSMITH VESTRY, Hammersmith, W. *L.A.93*	W. P. Cockburn	H. Mair	H. Mair	3/1	...
HAMPSTEAD VESTRY, Haverstock-hill, N.W..... *L.A.92*	A. P. Johnson.....	.....	C. H. Lowe	3/1	2/2
HOLBORN DISTRICT BOARD OF WORKS, Holborn Town Hall, Gray's-Inn-rd, W.C. *C.89*	Matthew H. Hale ...	.....	L. H. Isaacs	3/1	...
ISLINGTON VESTRY, Upper-st, N. *L.A.93*	W. Francis Dewey ..	.....	J. Patten Barber.....	3/1	...
KENSINGTON VESTRY, High-st, W.	Wm. Chambers Lecte	P. Monson, A.I.E.	W. Weaver, C.E. ...	3/1	2/2
LAMBETH VESTRY, Kennington-green, S.E. *L.A.92*	H. J. Smith.....	.....	H. M'Intosh	2/2 & 2/3	...

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LEWISHAM DISTRICT BOARD OF WORKS, Catford, S.E. *C.90*	Edward Wright	.....	J. Carline, C.E.....	2/6	...
LIMEHOUSE DISTRICT BOARD OF WORKS, Commercial-rd, E.	S. G. Ratcliff	.....	C. Dunch.....	3/1	...
MILE END VESTRY, Bancroft-rd, E.....	M. Jutsum	.....	J. M. Knight	3/1	...
NEWINGTON VESTRY, Walworth-rd, S.E. *C.89*	L. J. Dunham.....	.....	J. A. P. Waddington	2/6	63/9 each
PADDINGTON VESTRY, Harrow-rd, W. *C.90*	Frank Dethridge.....	.....	G. Weston	3/1	2/2
PLUMSTEAD DISTRICT BOARD OF WORKS, Old Charlton, S.E.....	G. Whale	.....	J. Rowland, H. Woods, J. L. Bennett, W. G. Forder	2/6	...
PLUMSTEAD VESTRY, Maxey-rd, S.E.	E. Hughes	.....	.....	...	...
POPLAR DISTRICT BOARD OF WORKS, High-st, Poplar, E. *L.A.93*	W. H. Farnfield	... ..	G. F. Holt	2/9	69/- each
ROTHERHITHE VESTRY, Lower-rd, S.E. *C.89*	J. J. Stokes	.....	G. Legg, E. Thomas	2/6	...
SHOREDITCH VESTRY, Old-st, E.C. *L.A.92*	H. M. Robinson, LL.D.	.....	A. J. Martin	3/1	2/2
ST. GEORGE'S (Hanover-sq.) VESTRY, Mount-st, W. *C.89*	J. H. Smith.....	.....	G. Livingstone, C.E.	3/1	2/2
ST. GEORGE'S-IN-THE-EAST VESTRY, Cable-st, E.	H. Thompson	.....	G. A. Wilson	2/9	...
ST. GEORGE THE MARTYR (Southwark) VESTRY, Borough-rd, S.E. *C.90,92*	A. Millar	.....	A. M. Hiscocks	2/6	...
ST. GILES (and St. George, Bloomsbury) DISTRICT BOARD OF WORKS, High Holborn, W.C. *C.89*	H. C. Jones	G. Wallace	G. Wallace	3/1	2/2
ST. JAMES (Westminster) VESTRY, Piccadilly, W.....*C.90*	(Vacant)	.....	H. Monson, C.E.....	3/1	2/2
ST. LUKE VESTRY, City-rd, E.C.	G. W. Preston	.....	M. C. Meaby	3/1	2/6
ST. MARTIN-IN-THE-FIELDS VESTRY, Town Hall, Charing Cross, W.C. *C.89*	G. W. Murnane	.....	C. Mason, A.M.I.C.E.	3/1	2/2
ST. MARYLEBONE VESTRY, Marylebone-lane, W. *C.89*	W. H. Garbutt	.....	H. Tomkins.....	3/1	2/2
ST. OLAVE DISTRICT BOARD OF WORKS, Southwark, S.E. *C.89*	Edric Bayley, M.A.	.....	G. W. Thompson, A.M.I.C.E., F.S.I.	2/6	2/3
ST. PANCRAS VESTRY, Pancras-rd, N.W. *L.A.83*	T. Eccleston Gibb ...	Prof. H. Robinson.....	W. N. Blair	3/1	2/2
ST. SAVIOUR'S DISTRICT BOARD OF WORKS, Bankside, S.E. ...*C.89, 91*	W. H. Atkins	.. ...	G. R. Norrish	2/3	63/9 each per ann.
STRAND DISTRICT BOARD OF WORKS, Tavistock-st, W.C.....*C.89, 91*	H. Andrews.....	H. Lea, Birmingham..	A. Ventris	3/1	...
WANDSWORTH DISTRICT BOARD OF WORKS, East-hill, S.W. *C.92*	H. G. Hills	.....	A. Southam, J.C. Radford, H. J. Marten, P. Dodd	2/6	...
WESTMINSTER VESTRY, Caxton st, Victoria-st, S.W. *C.89, 91*	J. E. Smith.....	.....	G. R. W. Wheeler...	3/1	...
WHITECHAPEL DISTRICT BOARD OF WORKS, Great Alie-st, E. *L.A.92*	A. Turner.....	.....	W. La Rivière.....	2/6	...
WOOLWICH LOCAL BOARD OF HEALTH, Woolwich *C.91*	A. C. Reed	.....	H. O. Thomas.....	2/6	...

L.A. or *C.* indicates that a Provisional Order or License for lighting the district by electricity was obtained by the Local Authority or a Company in the year given; and *g* means that the Local Authority owns the Gas Works.

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COUNTY COUNCILS.

County.	Population.	Chairman.	Clerk.	Surveyor.
ANGLESEY	50,098	Samuel Hughes	J. Lloyd Griffith, Holyhead	W. E. Jones, Llanfair.
BEDFORDSHIRE	160,704	Charles Howard	W. W. Marks	W. H. Leete.
BERKSHIRE	236,163	W. G. Mount, M.P.	J. T. Morland, Reading and Abingdon	J. Morris, Reading.
BRECONSHIRE	51,459	C. Evan-Thomas	H. Edgar Thomas, Brecon	William Williams.
BUCKINGHAMSHIRE	171,849	H. W. Cripps, Q.C.	W. Crouch, Aylesbury	R. J. Thomas.
CAMBRIDGESHIRE	185,822	Arthur Sperling, J.P.	Frederick Ryall, Wisbech (Deputy)	R. R. Rowe, Geo. J. Moore.
CAMBRIDGESHIRE (Isle of Ely)	63,861	William Cutlack Little	Hale Wortham, Shire Hall, Cambridge	W. M. Fawcett, M.A.
CARDIGANSHIRE	63,467	D. C. Roberts	H. C. Fryer, 52, Marine-ter., Aberystwith	R. Lloyd and D. Davies.
CARMARTHENSHIRE	120,066	Gwilym Evans	T. Jones, Llandovery	
CARNARVONSHIRE	115,533	John Hughes, J.P.	J. H. Roberts, Carnarvon	Evan Evans.
CHESHIRE	707,962	George Dixon	Reginald Potts, Chester	Stanhope Bull.
CORNWALL	318,601	Earl of Mount-Edgcumbe	H. S. Stokes, Bodmin	Silvanus W. Jenkin, Liskeard.
CUMBERLAND	266 550	Henry Charles Howard	C. B. Hodgson, Carlisle	Thos. James Hickes, Truro.
DENBIGHSHIRE	118,843	Samuel Moss	Ll. Adams, 5, Castle-st., Ruthin	G. J. Bell.
DERBYSHIRE	528,033	Sir Henry Wilmot, Bart., V.C., C.B.	C. S. B. Busby, Derby	R. Lloyd Williams.
DEVONSHIRE	631,767	Lord Clinton	H. Michelmore, The Castle, Exeter	J. S. Story.
DORSETSHIRE	194,517	Viscount Portman	E. Archdall Ffooks, Sherborne	E. H. Harbottle, J. Little, H. Masterton, C. G. S. Acock.
DURHAM	1,106,449	John Lloyd Wharton, M.P.	Ralph Simey, Durham	W. J. Fletcher, Wimborne.
ESSEX	784,258	Andrew Johnston	H. Gibson, Ongar	Wm. Crozier.
FLINTSHIRE	77,277	James Liebig Muspratt	T. T. Kelly, Mold	H. Stock, 9, Denman-st., S.E.
GLAMORGANSHIRE	467,954	Lord Swansea	T. Mansel Franklen, Cardiff	David Williams, Mold.
GLOUCESTERSHIRE	548,911	Sir John Edward Dorington, Bt., M.P.	E. T. Gardom, Shire Hall, Gloucester	T. Loyd Edwards, Bridgend.
HAMPSHIRE	386,849	Lord Basing	G. A. Webb, County Hall, Winchester	Robt. Phillips.
HEREFORDSHIRE	95,719	Col. Prescott Decie	J. F. Symonds, Hereford	J. Robinson, C.E.
HERTFORDSHIRE	224,550	Earl Cowper, K.G.	Sir R. Nicholson, St. Alban's, Herts	H. T. Wakelam.
HUNTINGDONSHIRE	57,761	Earl of Sandwich	Edward Maule, Huntingdon	Urban A. Smith, A.M.I.C.E.
ISLE OF WIGHT	78,263	Lt.-Gen. Hon. S. J. Gough-Calthorpe	John Wilson Fardell, Newport	R. Hutchinson.
KENT	787,700	Sir John Farnaby Lennard, Bt.	Walter Byron Prosser, Maidstone	Francis Newman, Ryde.
LANCASHIRE	3,923,096	Rt. Hon. Sir J. T. Hibbert, K.C.B., M.P.	F. Campbell Hulton, Preston	F. W. Ruck.
LEICESTERSHIRE	375,092	Hussey Packe	W. J. Freer, 10, New-st., Leicester	E. G. Paley, Ulverston; W. Radford, Manchester; G. Holme, L'pool.
LINCOLNSHIRE (Holland)	473,912	R. W. Staniland	F. Thirkill White, Boston	W. Beaumont Smith.
LINCOLNSHIRE...(Kesteven)		Sir Wm. Earle Welby-Gregory, Bart.	Joseph Phillips, Stamford	J. Kingston, Fosdyke.
LINCOLNSHIRE (Lindsey)		(Vacant)	Charles Scorer, Lincoln	Herbert Kirk, Sleaford.
LONDON	4,231,431	John Hutton, Chairman; Chas. Harrison, Vice-Chairman; W. H. Dickinson, Deputy Chairman.	H. De la Hooke	Jas. Thropp, C.E., Lincoln. Chief Engineer, A. R. Binnie; District Engineers, H. Bennett, J. E. Worth.

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MERIONETHSHIRE	49,212	Ald. A. Osmond Williams	Robert Jones, Portmadoc	John Morris Jones, Trawsfynydd.
MIDDLESEX	560,012	R. M. Littler, C.B., Q.C.	Sir R. Nicholson, Guildhall, Westminster	F. H. Pownall.
MONMOUTHSHIRE	258,133	Edwin Grove	Osmond A. Wyatt, J.P., Usk	Wm. Tanner, Newport.
MONTGOMERYSHIRE	58,003	A. C. Humphreys-Owen	Geo. Devereux Harrison, Welshpool	G. A. Hutchins.
NORFOLK	456,474	Robt. Thornhagh Gurdon	Chas. Foster, Norwich	T. H. B. Heslop.
NORTHAMPTONSHIRE	206,039	S. G. Stopford-Sackville	H. Philip Markham, Northampton; Christopher R. Markham (Deputy)	Edmund Law.
NORTHAMPTONSHIRE (The Soke of Peterborough)	25,172	Col. Chas. Isham Strong	Leonard John Deacon; W. J. Deacon (Deputy)	B. Williams.
NORTHUMBERLAND	506,030	Rt. Hon. Sir Matthew White-Ridley, Bt., M.P.	S. Sanderson, Moot Hall-courts, Newcastle	H. F. Sneyd-Kynnersley.
NOTTINGHAMSHIRE	445,823	Lord Belper	Jesse Hind, Nottingham	Edgar P. Hooley.
OXFORDSHIRE	137,681	Viscount Valentia	T. M. Davenport, M.A., Oxford	H. Jas. Tollit.
PEMBROKESHIRE	89,133	Lord Kensington	John Owen, Haverfordwest; W. D. George, Haverfordwest (Deputy)	Thomas George.
RADNORSHIRE	21,791	Lord Ormathwaite	Edward Wood, Rhayader and Presteign	S. W. Williams.
RUTLANDSHIRE	20,659	Earl of Gainsborough	Benjamin Addington Adam, Oakham	Jas. Richardson, Stamford.
SHROPSHIRE	236,224	S. K. Mainwaring	E. C. Peele, Shire Hall, Shrewsbury	Alf. T. Davis, C.E.
SOMERSETSHIRE	484,337	Sir R. Horner Paget, Bart., M.P.	Wm. Dunn, Frome	W. J. Willcox, Bath.
STAFFORDSHIRE	1,087,177	Earl of Harrowby	M. F. Blakiston, Stafford	W. H. Cheadle.
SUFFOLK (East)	183,478	Lord Henniker	J. Cherry, Ipswich; S. Westhorp, Ipswich (Deputy)	Hy. Miller, Ipswich.
SUFFOLK (West)	120,952	Col. N. Barnardiston		F. Whitmore, Chelmsford.
SURREY	1,436,899	E. J. Halsey	Sir R. H. Wyatt, Kingston	F. G. Howell.
SUSSEX (East); SUSSEX (West)	548,979	Earl of Chichester; Duke of Richmond and Gordon, K.G.	F. Merrifield, Lewes	Henry Card, Lewes
WARWICKSHIRE	806,070	J. Stratford Dugdale, Q.C.	F. Merrifield, Lewes	Chas. Adcock, Bognor.
WESTMORELAND	66,098	James Cropper	A. S. Field, Leamington	John Willmot, Birmingham.
WILTSHIRE	264,970	Marquis of Bath	John Bolton, 14, Kent-st., Kendal	Jos. Bintley.
WORCESTERSHIRE	296,659	J. W. Willis Bund	R. W. Merriman, Marlborough	C. S. Adye, Bradford.
YORKSHIRE (East Riding)	399,412	Sir Charles Legard, Bart.	W. Nicholas Marcy, Worcester	H. Rowe, Worcester.
YORKSHIRE (North Riding)	284,837	Hon. G. E. Lascelles, J.P.	J. J. Bickersteth, Beverley	A. Beaumont, Beverley.
YORKSHIRE (West Riding)	2,444,931	Charles George Milnes-Gaskell, J.P.	Thos. Lawrence Yeoman, Northallerton	Walker Stead, Northallerton.
			F. A. Darwin, Wakefield	J. Vickers Edwards, Wakefield.

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COUNTY BOROUGHS.

County Borough.	Populat'n.	Mayor.	Town Clerk.	Lighting Engineer.	Surveyor.	Price of Gas. Prvte. Consmrs.	Price of Gas. Pub. Lamps
BARROW-IN-FURNESS ....*g*	51,712	James W. Little, J.P...	C. F. Preston	W. H. Fox, C.E. ...	W. H. Fox, C.E. ...	3/–	52/– each.
BATH *C.90*	51,843	Lt.-Gen.R.G.Mainwaring	J. Stone	Alfred Mitchell	C. R. Fortune	2/8	2/6
BIRKENHEAD .....*L.A.90, g*	99,857	W. Benedict Jones ...	A. Gill	T. C. Thorburn, C.E.	T. C. Thorburn, C.E.	2/6 & 2/9	56/6 each
BIRMINGHAM .....*C.89, C.91, g*	478,113	Ald. G. J. Johnson ...	E. O. Smith.....	C. Hunt, H. Hack...	W. S. Till	2/3 to 2/7	1/1
BLACKBURN ..... *L.A.90, g*	120,064	T. M. Eccles, J.P.....	Robert E. Fox.....	J. B. McCallum	J. B. McCallum	3/1 & 3/4	3/1
BOLTON .....*L.A.91, g*	115,002	Ald. W. Nicholson ...	R. G. Hinnell	John H. Ryder	W. H. Brockbank ...	2/8 to 3/2	2/8
BOOTLE	49,217	Ald. Ben S. Johnson...	J. H. Farmer	.:....	J. A. Crowther	3/–	...
BRADFORD .....*L.A.83, g*	216,361	Jonas Whitley	W. T. McGowen.....	S. W. Baynes	J. H. Cox.....	2/3	free.
BRIGHTON .....*L A 83*	115,402	Ald. Joseph Ewart, M. D	Francis John Tillstone	F. J. C. May	F. J. C. May	2/9 to 4/9	...
BRISTOL *L.A.83*	223,592	R. H. Symes	D. Travers Burges ..	F. Ashmead	F. Ashmead	2/10	2/8
BURNLEY .....*L.A.90, g*	87,058	Ald. Christian Mitchell	W. T. Fullalove	F. Thursfield, B.A...	F. S. Button	2/9 to 3/10	50/– each.
BURY .....*C.90, g*	57,212	John Ashworth	John Haslam	.....	J. Cartwright	2/8 & 3/7	2/8 & 3/7
CANTERBURY *L.A.91*	23,026	George Collard	Henry Fielding	F. Baker, C.E.	F. Baker, C.E.	2/9 to 3/–	73/6 each.
CARDIFF.....*L.A.91*	136,181	W. J. Trounce	J. L. Wheatley	W. Harpur	W. Harpur	3/– & 3/6	56/– each.
CHESTER.....*L.A.90*	41,603	Ald. L. Gilbert	S. Smith	I. Matthews Jones ...	I. Matthews Jones ...	3/8	66/– each.
COVENTRY.....*L.A.91, g*	52,724	Ald. George Singer ...	Lewis Beard..	.....	E. J. Purnell	2/6 to 2/8	51/7 each.
CROYDON *L.A.91*	109,000	Ald. S. Lee Rymer, J.P.	C. M. Elborough.....	T. Walker	T. Walker	2/10	2/10
DERBY *L.A.90*	94,146	J. P. Doherty.....	H. F. Gadsby	Bramwell and Harris	R. J. Harrison.....	2/3 to 2/8	2/3
DEVONPORT	54,736	W. Waycott	J. J. E. Venning.....	J. F. Burns	J. F. Burns	2/6	..
DUDLEY	45,740	Ald. G. H. Claughton.	E. M. Warmington...	.....	J. Gammage	2/9 to 3/–	52/6 each.
EXETER *C.91*	37,580	Ald. E. J. Domville, J.P.	G. R. Shorto	D. Cameron	D. Cameron	3/1	2/9
GATESHEAD	85,742	Ald. Dunn	W. Swinburne.....	.....	James Bower	1/10	1/– weekly
GLOUCESTER	39,239	John Albert Matthews.	G. S. Blakeway	.....	R. Read	2/6	2/6
GREAT GRIMSBY	51,876	Ald. G. Doughty	W. Grange	.....	Marshall Petree	2/11	52/6 each.
GREAT YARMOUTH *L.A.90*	49,318	Richard Martins.....	T. M. Baker.....	.....	J. W. Cockrill.....	3/4	3/3
HALIFAX .....*L.A.92, g*	91,500	Ald. S. T. Midgley, J.P.	K. Walton	.....	.....	2/2	2/2
HANLEY *L.A.91*	54,946	Ald. E. J. Hammersley	A. Challinor.....	.....	Joseph Lobley.....	3/–	60/– each.
HASTINGS *L.A.90, C.90*	52,340	Ald. B. H. W. Tree ...	B. F. Meadows	P. H. Palmer, C.E.	P. H. Palmer, C.E.	3/4	84/2 each.
HUDDERSFIELD..... .....*L.A.90, g*	95,420	Ald. J. J. Brook.....	H. Barber, LL.B. ...	A. B. Mountain	R. S. Dugdale, C.E...	2/9	30/– each.
IPSWICH *C.91*	57,260	S. R. Anness, J.P.....	W. Bantoft	E. Buckham, M.I.C.E.	E. Buckham, M.I.C.E.	2/10	2/10

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KINGSTON-UPON-HULL *L.A.90*	208,639	Charles Richardson ...	R. Hill Dawe	A. E. White, C.E. ...	A. E. White, C.E. ...	3/-	43/6 each.
LEEDS ..... *C.91, g*	390,000	T. R. Lenty.....	John Harrison	T. Hewson, C.E.....	T. Hewson, C.E.....	2/2	2/4
LEICESTER..... *L.A.90, g*	187,000	Ald. Israel Hart.....	John Storey.....	E. Mawbey, M.I.C.E.	E. Mawbey, M.I.C.E.	2/4	2/2
LINCOLN ..... *g*	41,491	A. W. Hall	J. T. Tweed.....	H. Teague, W.E. ...	R. A. MacBriar	2/6	2/6
LIVERPOOL *C.89, 91, 92*	517,980	Rt. Hon. Ald. W. T. Bowring (*L.M.*)	G. J. Atkinson	H. P. Boulnois, M.I.C.E.	H. P. Boulnois, M.I.C.E.	3/-	63/- each.
MANCHESTER ..... *L.A.90, g*	515,998	Rt. Hon. Ald. A. Marshall (*L.M.*)	W. H. Talbot	J. Allison.....	J. Allison.....	2/6 to 3/-	free in city
MIDDLESBOROUGH ..... *g*	75,532	Thomas Baker	G. Bainbridge	D. Terrace	E. D. Latham, C.E.	2/-	2/-
NEWCASTLE-UPON-TYNE... *C.91, C 93*	197,026	Alt. S. Quin	Hill Motum.....	W. G. Laws.....	W. G. Laws.....	1/10	1/- weekly.
NEWPORT (Mon.) *L.A.91*	55,000	Frederick Phillips	A. A. Newman	R. H. Haynes.....	R. H. Haynes.....	2/10 & 3/-	57/- each.
NORTHAMPTON	61,778	Ald. H. E. Randall ...	W. Shoosmith	J. Eunson	W. Ibbs Brown	2/4	1/11
NORWICH *C.91*	104,000	Sir Peter Eade, M.D...	G. B. Kennett	.. ...	John Buchan	3/10	58/6
NOTTINGHAM..... *L.A.90, g*	220,000	Ald. F. Pullman.....	Sir S. G. Johnson ...	A. Brown, M.I.C.E.	A. Brown, M.I.C.E.	2/4 to 2/6	2/4
OLDHAM ..... *L.A.90, g*	131,463	Ald. J. Smith	A. Nicholson	A. Foote, C.E.....	A. Foote, C.E.....	3/-	free.
OXFORD ..... *C.90 (92)*	45,741	Ald. W. Gray.....	J. J. Bickerton, M.A.	W. H. White	W. H. White	2/8	55/4½ each.
PLYMOUTH	84,179	W. Law, J.P..... ...	J. H. Ellis	G. D. Bellamy	G. D. Bellamy	1/9	51/3
PORTSMOUTH and SOUTHSEA.. *L.A.90*	159,255	A. L. Emanuel, J.P....	A. Hellard	.....	Philip Murch	2/4 & 3/4	65/-
PRESTON	110,225	John Holden M.D. ...	H. Hamer	H. Reah	H. Reah	2/11 & 3/1	2/11
READING..... *C.93*	62,000	C. G. Field	H. Day.....	Arthur Collins	Arthur E. Collins ...	3/-	52/8 each.
ROCHDALE .... *g*	71,401	James Cheetham	Z. Mellor	S. S. Platt	S. S. Platt	2/0 to 3/7	free.
ST. HELENS ..... *g*	71,288	Arthur Sinclair, J.P....	W. J. Jeeves	G. J. C. Broom	G. J. C. Broom	2/9	2/9
SALFORD ..... *L.A.90, g*	198,136	Ald. W. H. Bailey ...	S. Brown	J. Corbett.....	J. Corbett.....	2/3 to 3/1	2/4 to 3/1
SHEFFIELD..... *C.92*	334,585	Ald E. S. Foster	J. W. Pye-Smith	C. F. Wike, C.E. ...	C. F. Wike, C.E. ...	1/10 to 2/2	1/10
SOUTHAMPTON *C.90*	65,325	Ald. W. Bone, J.P. ...	J. Moore Hayton, B.A.	W. B. G. Bennett ...	W. B. G. Bennett ...	2/10 & 3/4	2/10 & 3/4
SOUTH SHIELDS..... *L.A.91*	78,391	Robert Readhead, J.P.	W Hyde	J. A. Jeckell.....	M. Hall	2/6	1/- weekly.
STOCKPORT .... *L.A.91, g*	72,400	John Turner	F. M. Bowey	S. Meunier	John Atkinson	2/8	55/3
SUNDERLAND..... *L.A.91*	134,394	J. Sanderson J.P.....	J. Thomas	R. S. Rounthwaite ...	R. S. Rounthwaite ...	1/6 to 1/11	44/6 each.
SWANSEA *L.A.89*	90,345	Lt.-Col. W. Pike	J. R. Cooper	R. H. Wyrill	G. Bell	3/4	3/-
WALSALL ..... *L.A.90, g*	71,791	T. P. Brownhill	A. Caddick	R. H. Middleton.....	R. H. Middleton.....	2/6	47/6 each.
WEST BROMWICH .. .. *g*	59 489	Ald. R. Farley	F. E. Hilleary, LL.D.	J. T. Eayrs	J. T. Eayrs	2/3 to 2/8	50/10 each.
WEST HAM *L.A.92*	204,902	Ald. J. H. Bethell, J.P.	A. Smith, B.A, LL.B.	Lewis Angell, M.I.C.E.	Lewis Angell, M.I.C.E.	3/2	72/-
WIGAN ..... *L.A.90, g*	55,013	N. F. Eckersley.....	Horatio Brevitt	W. Bolton	W. Bolton	3/- & 3/6	2/4½
WOLVERHAMPTON *L.A.90*	82,622	C. T. Mander, J.P. ...	S. Southall	R. E. W. Berrington,	R. E. W. Berrington	2/6	2/6
WORCESTER *L.A.90*	42,908	G. H. Williamson	G. McGuire	S. G. Purchas, C.E....	S. G. Purchas, C.E....	2/9	2/5
YORK *L.A.90*	66,984	Rt. Hon. Ald. T. Clayton (*L.M.*)	.....	.....	Alfred Creer.....	2/- to 2/3	47/8 each.

L.A. or *C.* indicates that a Provisional Order or License for Lighting the district by electricity was obtained by the Local Authority or a Company in the year given; and *g* means that the Local Authority owns the Gas Works.

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PROVINCIAL BOROUGHS AND LOCAL BOARDS.

Place.	Population.	Chairman or Mayor.	Clerk.	Engineer.	Surveyor.	Price of Gas. Prvte. Consmrs.	Pub. Lamps.
Aberdare (L.B.)	38,513	Rees Hopkin Rhys	T. Phillips	.....	Owen Williams	4/- & 4/3	4/-
Abergavenny (I.A.) *g*	7,800	J. Bishop	J. T. Rutherford	S. Cross (Gas)	J. Haigh	2/11 to 3/2	Free.
Aberystwith (L.B.)	15,296	W. P. James	E. Cooke	.....	E. Cooke	3/- to 3/9	3/6
Aberystwith (B.) *L A 92*	6,696	T. D. Harries	A. J. Hughes	.....	Rees Jones	4/1 to 4/7	4/1
Abingdon (B.)	6,557	Edward Morland	Bromley Challenor	.....	G. Winship	4/5 to 4/10	4/5
Accrington (B.) *L.A.90, g*	38,603	Ald. T. N. Haywood	A. H. Aitken	.....	W. J. Newton	3/0½ to 3/3½	2/11
Acton (L.B.) *L.A.91*	17,100	H. W. Blake	A. Hemsley	.....	D. J. Ebbetts	3/6	2/2
Aldershot (L.B.)	20,140	W. T. Robertson	W. E. Foster	.....	B. Rushford	3/1	3/1
Alnwick and Canongate (L.B.)	6,693	J. L. Newbigin	R. Middlemas	.....	G. Wilson	3/4	50/- each.
Altrincham (L.B.) *C.93*	12,424	W. Griffin	J. Stokoe	.....	J. Stokoe	3/2	3/1
Alverstoke (L.B.)	21,571	Col. Mumby	E. Talbot Palmer	.....	W. H. Fry, A.M.I.C.E.	3/9	...
Ashford (L.B.)	10,770	Thomas Edwards	F. Hughes-Hallett	.....	W. Terrill	3/4	42/6 each.
Ashton-in-Makerfield (L.B.) *g*	14,500	J. Gaskell	James Hill	.....	F. C. Hodgkinson	3/3 to 4/6	5/-
Ashton-under-Lyne (B.) *L.A.92*	40,494	Ald. Ely Andrew, J.P.	C. Gartside	.....	J. T. Earnshaw, C.E.	2/4	2/4
Aspull (L.B.)	8,954	W. H. Hewlett	Louis Athron	.....	George Heaton	3/1⅛	2/9⅜
Aston Manor (L.B.)	68,639	R. L. Spokes	J. Ansell	W. A. Davies	W. A. Davies	2/3	...
Atherton (L.B.) *g*	15,000	R. Fletcher	D. Schofield	.....	W. Clough	3/9	3/2
Audley (L.B.) *g*	13,600	Frank Rigby	J. J. Nelson	Chris. Warburton	Chris. Warburton	3/6	3/-
Aylesbury (L.B.)	7,795	Thomas Horwood	George Fell	.....	J. H. Bradford	3/5 to 4/2	49/- each.
Bacup (B.) *L.A.90*	23,498	Ald. Thomas Disley	J. Heyworth	John Wilson, C.E.	John Wilson, C.E.	3/- to 3/4	38/- each.
Balsall Heath (L.B.)	22,497	J. R. C. Taunton	B. Weekes	.....	Sam. Owen	2/3	...
Banbury (B.)	12,822	T. O. Hankinson	O. J. Stockton	.....	S. E. Burgess, C.E.	2/10 & 3/1	53/6 each.
Bangor (B.) *g*	10,113	Ald. D. Cameron	R. Hughes Pritchard	J. Smith	J. Gill, C.E.	2/6 to 3/6	3/6
Barking Town (L.B.)	14,301	T. W. Glenny	C. E. Wilson	.....	C. J. Dawson	4/6	...
Barnet (L.B.) *L.A.93*	4,095	Charles Stevens	H. W. Poole	.....	W. H. Mansbridge	4/-	...
Barnsley (B.) *L.A.90*	35,427	Dr. M. C. S. Halton	H. Horsfield	J. H. Taylor	J. H. Taylor	2/10 to 3/4	40/- each.
Barnstaple (B.)	13,058	Col. H. R. Hibbert	J. Bosson	.....	R. D. Gould	3/9	53/6 each.
Barton, (L.B.)	28,500	Robert Spong	Horatio R. Dix	.....	D. Houghton	2/11	31/- each.
Basingstoke (B.)	7,960	Ald. John May	W. H. Bayley	.....	Harry Budden	3/9 to 4/2	70/- each.
Batley (B.) *g*	29,000	Joseph Wilson	J. H. Craik	J. F. Bromley (Gas)	Henry Dearden	2/3 to 2/10	1/6
Beckenham (L.B.) *C.90, L.A.93*	20,705	Arthur Henry Baker	F. Stevens	G.B.Carlton, A.M.I.C.E.	G. B. Carlton	2/6	59/6 each.
Bedford (B.) *L.A.90*	30,000	George Wells, J.P.	J. P. Piper, M.A.	.....	J. Lund	3/-	46/3
Bedlingtonshire (L.B.)	14,510	Rev. Canon C.T. Whitley	C. D. Forster	.....	C. A. Copland	5/-	17/6
Belgrave (L.B.)	7,260	L. A. Clarke	J. B. Waring	.....	R. J. Stephens	2/4	..
Belper (L.B.)	10,420	G. H. Strutt	Joseph Pym	.....	W. H. Simkins	3/3	40/- each.
Berwick-upon-Tweed (B.)	13,377	Joseph Weatherston	R. Douglas	Robert Dickinson	Robert Dickinson	4/10	4/10
Bethesda (I.A.) *g*	6,969	John Jones	R. B. Evans	.....	Morris Davies	6/3	Free.
Beverley (B.) *g*	12,529	Tom Turner, J.P.	J. Mills	.....	G. S. Hird	3/4	36/10 each.
Bexley (L.B.)	8,793	H. J. Bristow	Sidney Matthews	.....	E. R. Boulter	...	...

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BIDEFORD (B.)....*g*	7,908	Robert Dymond.....	C. W. Hole	.....	Henry Chowins	4/-	51/6 & 86/-
BILSTON (L.C.)	23,450	T. Johnson	J. D. Wassell	.....	C. N. Wilson	2/7½ & 3/-	2/7½
BINGLEY (L.B.) ..... *g*	10,023	F. Binns	Alfred Platts	.....	Thos. Bottomly	2/10	2/8
BIRKDALE (L.B.)	8,705	T. O. Clinning	John Smallshaw	.....	J. H. Fairbairn	2/9 to 4/6	...
BISHOP AUCKLAND (L.B.)	10,500	Ralph Nelson	J. T. Proud	.....	R. Lindsay	3/3	3/1
BISHOP STORTFORD (L.B.)	6,704	T. N. Miller	William Gee	.....	R. S. Scott	3/6 & 4/-	65/- each.
BLACKPOOL (B.) .....*L.A.90, g*	23,846	Ald. J. Cardwell	T. Loftos	J. Hesketh (Electrical	John Phillips	2/6	2/6
BLAENAVON (L.B.)	11,454	John Worton	J. Thomas	.....	F. MacDonald..	3/- & 3/6	3/6
BLAYDON (L.B.)	13,369	John Anthony Cowen..	Henry Dalton	.....	W. S. Simpson	1/10	..
BOGNOR (L.B.) *C.90*	3,290	Arthur Smith	H. L. Staffurth	.....	W. L. Barrett.....	4/6	4/6
BOSTON (B.)	14,593	S. Waddington	R. W. Staniland.....	W. H. Wheeler	W. H. Wheeler	3/6	3/9
BOURNEMOUTH (B.) *C.90*	37,650	Ald. G. M. Hirons.....	J. Druitt, jun.	.....	F. W. Lacey	3/6	3/6
BRAMPTON AND WALTON (L.B.) ...	7,567	W. B. Robinson.....	S.E. Swaffield	.. ...	Alfred Cupit	4/2	31/- each.
BRANDON AND BYSHOTTLES (L.B.)...	13,000	A. L. Steavenson	J. G. Wilson	.. ...	R. Gardner	5/3	37/6 each.
BRENTFORD (L.B.)	12,000	Thomas Layton	S. Woodbridge	.. ...	J. H. Strachan	3/-	2/11
BRIDGEND (L.B.).....*L.A,93*	4,500	.....	T. J. Hughes	.....	Morgan Williams ...	4/6	4/-
BRIDGWATER (B.)	12,383	Henry W. Pollard.....	P. O. H. Reed.....	F. Parr	F. Parr.....	2/6½ to 3/-	57/- each.
BRIDLINGTON (L.B.)...	8,909	G. G. O. Sutcliffe	Charles Gray	R. R. Brown, jun....	R. R. Brown, jun....	...	...
BRIDPORT (B.)	6,611	F. Jones	F. W. Gundry.....	.....	F. Cooper..	3/9	28/3
BRIERLEY HILL (L.B.)	11,832	John Skidmore	William Waldron ...	.....	J. W. Beckley.....	2/10 to 3/6	52/6 each.
BRIGHOUSE (B.) ....*g*	10,275	William Smith	James Parkinson ..	.....	Emmerson Brooke ...	2/6	cost price.
BROMLEY (L.B.) *L.A.91*	21,685	James Batten	F. H. Norman	.. ..	S. Hawkings	3/-	70/6 each.
BROMSGROVE (L.B.).....	7,960	William Jefferies	B. H. Sanders.....	.....	R. H. Nowell	3/6 to 4/4	55/- each.
BROWNHILLS (L.B.)	13,703	J. T. Bayley	T. H. Stanley	.....	J. H. Shaw	4/8 to 5/8	...
BURSLEM (B.) .....*g*	32,251	Ald. S. Lawton	Arthur Ellis.....	.. ...	F. Bettany	3/3	3/3
BURTON-UPON-TRENT (B.) *L.A.90, g*	46,047	Ald. A. J Coxon	T. N. Whitehead ...	F. L. Ramsden	J. E. Swindlehurst...	2/7 to 4/3	59/6 each.
BURY ST. EDMUNDS (B.).....*L.A.84*	16,630	A. J. Hooper	C. E. Salmon	.....	J. Campbell - Smith.	3/8	2/4½
CAMBORNE (L.B.)	14,608	A. J. Tangye	J. R. Daniell	.....	T. Negus	4/5 to 5/-	4/5
CAMBRIDGE (B.).....*C.93L.A.90*	36,983	E. H. Parker	J. E. L. Whitehead...	.. ..	E. W. Harry	2/10	57/9 each.
CANNOCK (L.B.)	20,613	J. Williamson.....	C. A. Loxton, LL.B..	.. ..	J. Peake	3/- to 4/-	42/6 each.
CARLISLE (B.) .....*L.A.83, g*	39,176	John Corbett, J.P. ...	A. H. Collingwood ...	.. ..	W. Howard Smith ...	2/3	40/- each.
CARMARTHEN (B.)	10,333	Henry Cadle	R. M. Thomas.....	.....	J. Morgan	4/8 & 4/10	4/6
CARNARVON (B.).....*g*	9,804	John Isscord Davies ...	J. H. Roberts	.. ...	R. O. Wynne-Roberts	4/- & 4/6	60/- each.
CASTLEFORD (L.B.)	10,523	J. Farquhar.....	H. H. Broadbent ...	.. ..	J. W. Lewis	3/0	3/6
CHADDERTON (L.B.).....	22,087	James Chadwick	George Taylor	.. ..	William Eckersley ...	2/10	...
CHATHAM (B.) *C.90*	59,389	Charles T. Smith	H. P. Mann	.. ..	Chas. Day	2/1 & 2/6	1/5
CHEADLE AND GATLEY (L.B.)	7,338	J. Dyson	T. H. Duckworth ...	.....	Edward Sykes.....	...	...
CHELMSFORD (B.) *C.90*	11,008	T. J. D. Cramphorne..	T. Dixon	.....	G H. Sasse	3/6 to 4/-	...
CHELTENHAM (B.) *L.A.90*	42,914	Ald. E. Wethered.....	E. T. Brydges.....	.....	J. Hall.....	2/6	2/4
CHERTSEY (R.S.A.)(*C.92*), incl. WEYBRIDGE (*C. 91*), WOKING (*C. 90*)	...	.....	H. E. Paine	.. ..	.....	3/8	66/- each.
CHESHUNT (L.B.)	7,735	T. A. Hewitt	A. Collingwood Lee..	.....	S. Towlson	...	...

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PROVINCIAL BOROUGHS AND LOCAL BOARDS—*continued.*

Place.	Population.	Chairman or Mayor.	Clerk.	Engineer.	Surveyor.	Price of Gas. Prvte. Consmrs.	Price of Gas. Pub. Lamps.
Chesterfield (B.)	23,800	Ald. W. B. Robinson...	J. Middleton	W. Stanton	W. Stanton	3/3 to 4/-	3/3
Chichester (B.)	7,842	Ald. W. Smith, J.P....	E. Arnold		H. W. Stringfellow..	4/3	77/- each.
Chiswick (L.B.) *L.A.91*	22,000	W. J. Compton	R. F. Finnis	A. Ramsden	A. Ramsden	3/-	57/4 each.
Chorley (B.) *g*	23,082	James Lawrence	John Mills		W. Leigh	3/3 to 3/9	3/-
Cirencester (L.B.)	7,500	Henry Zachary	Robert Ellett		W. H. Holland	4/3	47/6 to 65/- ea.
Clay Cross (L.B.)	6,879	J. Dickinson	James Stollard		T. G. Griffins	3/9	25/- each.
Cleator Moor (L.B.) *g*	9,464	J. F. Kirkconel	H. Rothery		Fred. J. Edge	3/9	...
Cleckheaton (L.B.) *g*	11,826	George T. Bull	J. Armitage	G. H. Nurn	J. Oldroyd	3/-	Free.
Clitheroe (B.) *g*	10,815	Tom Garnett	J. Eastham		J. Barrett	3/- to 3/6	2/6 ea. 100 hr
Colchester (B.) *L.A.93*	34,559	Henry Goody, J.P.	H. C. Wanklyn	H. Goodyear	H. Goodyear	3/6	3/-
Colne and Marsden (L.B.) *g*	16,800	Samuel Catlow	Alfred Varley		J. Mallinson	3/-	2/4 ea. 100 hr
Congleton (B.) *g*	10,744	Ald. R. Shepherd	J. Wilson, LL.D.		R. Burslam	3/4	Free.
Consett (L.B.)	8,103	William Jenkins	T. W. Welford, jun.		William Rippon	...	...
Coseley (L.B.)	21,700	Ed. Wones	J. Smith		C. W. Shackelton	3/-	...
Cowpen (L.B.)	10,003	Thos. Edgar Jobling	R. T. Guthrie		Thomas Maddison	3/5	3/5
Crewe (B.)	35,000	Chas. H. Pedley	F. Cooke	G. Eaton-Shaw	G. Eaton-Shaw	2/9	...
Crompton (L.B.)	13,000	John Wolstencroft	John H. Mills		John H. Mills	...	...
Dalton-in-Furness (L.B.) *L.A.85*	13,300	John W. Lawn	J. Tyson		C. C. Smith, M.S.I.	3/9	3/9
Darlaston (L.B.)	14,700	Enoch Horton	J. Corbett		J. C. Joynson	...	1/1
Darlington (B.) *L.A.90, g*	38,060	G. W. Barlett	F. T. Steavenson	T. Smith	T. Smith	2/2	60/- each.
Dartford (L.B.)	11,906	Charles N. Kidd	J. C. Hayward		W. Harston	3/6	61/- each.
Darwen (B.)	34,192	James Cocker	C. Costeker		W. Stubbs	2/9 to 3/-	47/6 ea 2,200 hr
Dawley (L.B.)	9,200	J. Machin	Owen W. Harries		W. H. Bailey	5/5	2½d. ea. p.nt.
Deal (B.)	8,891	George Cotten	A. C. Brown	R. W. Redman	R. W. Redman	3/10	3/7
Denbigh (B.)	6,412	Howel Gee	John Parry Jones		John Davies	4/- & 4/6	24/- each.
Denton and Haughton (L.B.) *g*	12,711	H. T. Denton	John Richards		G. H. Newton	2/6 to 2/11	2/6
Devizes (B.) *g*	6,426	Ald. G. H. Mead	J. T. Jackson, B.A.		F. G. Billingham	3/4	62/6 each.
Dewsbury (B.) *L.A.91, g*	29,847	Ald. Asa H. Pyrah	E. Mawdesley, B.A.,	H. C. Marks	H. C. Marks	2/3 & 3/-	Free
Doncaster (B.) *g*	25,936	F. W. Masters	T. B. Sugden [LL.B.	W. H. R. Crabtree	W. H. R. Crabtree	3/10	50/- each
Dorchester (B.)	7,946	George Davis	H. Symonds		Gilbert J. Hunt	4/9	52/6 for 10 ms.
Dorking (L.B.)	7,200	R. S. Cook	George Scales		G. S. Mathews	4/2	3/9
Dover (B.) *L.A.90*	33,300	Sir W. H. Crundall	E. W. N. Knocker	W. Thomas	W. Thomas	5/-	72/- each.
Droylsden (L.B.)	8,687	Jos. Hadwen	John Richards		Washington Hurst	...	...
Dukinfield (L.B.) *g*	17,408	George Taylor	J. A. Garforth	Harrison Veevers, C.E.	Harrison Veevers, C.E.	2/6 to 2/11	2/6 to 2/11
Durham (B.)	14,863	Ralph Charlton	F. Marshall	J. Coldwell	J. Coldwell	2/8 to 3/11	2/8
Ealing (L.B.) *L.A.91*	24,000	E. M. Nelson, J.P.	W. Ruston	C. Jones, A.M.I.C.E.	C. Jones, A.M.I.C.E.	3/3	2/11
Eastbourne (B.) *C.90*	34,977	Ald. H. W. Keay	H. W. Fovargue		R. M. Gloyne	3/2	3/2
East Ham (L.B.)	10,706	Thomas Mathews	C. E. Wilson		William H. Savage	3/-	2/7
East Stonehouse (L.B.)	15,125	A. E. Lyons	R. R. Rodd, jun.		J. L. Hodge	2/6	...

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ECCLES (B.) *L.A.93*	...	Samuel Mellor	G. W. Bailey	....	A. C. Turley	...	...
EBBW VALE (L.B.)	17,000	T. Morgan	J. E. Ward	T. J. Thomas	T. J. Thomas	5/-	4/-
ECCLESHILL (L.B.)	7,037	W. Smith	J. Richardson	... ...	T. Hutton	3/4	3/4
EDMONTON (L.B.).....	22,942	H. B. May	W. F. Payne	G. Eedes Eachus	G. Eedes Eachus.....	3/2	...
ELLAND (L.B.)	8,278	J. W. Smithies	Thomas England ..	.....	P. H. Whitwam	2/8½	2/8½
ELY (L.B.).....	8,171	Charles Bidwell	G. S. Hall	.....	William McKelvie ...	5/-	66/6 each.
ENFIELD (L.B.).....	22,000	James Meyer	T. W. Scott.....	.....	W. Kitteringham ...	4/1 & 4/4	3/9
EPSOM (L.B.).....	6,916	J. Andrews.....	George White	.....	E. R Capon	3/10	3/10
ERITH (L.B.).....	9,812	C. A. Streeten	Frederick Parish.....	.....	H. Hind	4/6	3/-
ETON (L.B.) .....*C 90*	3,464	Rev. T. Dalton	G. H. Long.....	.....	J. Simmonds	4/6	3/6
FAILSWORTH (L.B.)	7,912	Samuel Tong	Jonathan Taylor.....	.....	C. J. Lomax	...	...
FAREHAM (L.B.) *C.92*	6,658	J. Ramsay	Leonard Warner.....	W. J. Lomax	Walter Butler.....	3/9	3/9
FARNWORTH (L.B.)	23,758	J. C. Clarke	D. Crossley	.....	W. J. Lomax	2/10 to 3/6	2/10
FAVERSHAM (B.)	10,478	Jabez Smith	F. F. Giraud	.....	E. Pover	3/3	75/- each.
FELLING (L.B.).....	17,470	Lt.-Col. A. S. Palmer...	G. Bolam	.....	H. Miller.....	1/10	45/- each.
FENTON (L.B.).. .....*g*	16,998	William Hawker	C. Adderley.....	.....	S. A. Goodall	2/3 to 3/3	57/6 each.
FESTINIOG (L.B.) .....*g*	11,073	A. M. Dunlop	R. W. Davies	.....	H. P. Maybury	5/6	5/6
FINCHLEY (L.B.)	16,639	H. H. Wells	C. Roberts	F. Smythe	F. Smythe	...	4/- to 4/4
FLEETWOOD (I.A.) *L.A.90*	9,274	J. F. Marginson.....	Joseph Tildsley	.....	M. S. Gaulter	4/2	3/7
FOLKESTONE (B.)	23,812	T. J. Vaughan	W. G. S. Harrison ...	.....	John White.....	3/3	3/3
FRIERN BARNET (L.B.)	6,424	Rev. G. Hennessy	E. Goodship.....	.....	E. J. Reynolds	4/-	57/6
FROME (L.B.).....	9,613	E. G. Ames	G. W. Bradbury.....	... ..	P. Edinger	3/4	2/8
GAINSBOROUGH (L.B.).....	14.000	Edward Pearson	D. M. Robbs	.....	D. G. Macdonald ...	3/4	3/4
GARSTON (L.B.)	10.271	John E. Sheppard	P. F. Garnett	.....	F. W. Bowden	...	...
GILLINGHAM (L.B.) *C.90*	30,745	William Tozer	J. Bassett.....	.....	C. Candler	2/1 & 2/6	1/6
GLOSSOP (B.)	22,414	Edward Woolley	T. M. Ellison	.....	T. Haynes	3/- to 3/10	22/- each.
GOLCAR (L.B.)	7,653	William Crowther	A. J. Slocombe	.....	F. Sykes	...	...
GOOLE (L.B.).....	16,000	George Gleadow	G. England	E.C. Buchanan-Tudor	E.C. Buchanan-Tudor	4/3	4/3
GORTON (L.B.)	15,000	Thomas Matthews.. ..	R. T. Holland.....	.....	Charles Lomax	3/2	...
GRANTHAM (B.)	16,746	Arthur Hutchinson ...	A. H. Malim	.....	Joseph Evans	2/5½ & 2/8½	52/6 each.
GRAVESEND (B.)	24,067	E. C. Paine.....	Charles E. Hatten ...	.....	W. Gould..... ...	3/-	51/6 each.
GUILDFORD (B.)	14,316	G. Taylor, J.P.	F. Smallpeice	.....	F. T. Maltby	3/-	60/- each.
HANDSWORTH (STAFFS.) (L.B.)	32,756	Joseph Harris	H. Ward	.....	E. Kenworthy.....	...	...
HANDSWORTH (YORKS) (L.B).....	7,645	W. Birks.....	Nathaniel Creswick..	... ..	John Hardcastle.....	3/9	19/3ea 1,000hr
HARROGATE (B.) *L.A.91*	13,917	Ald. C. Fortune, J.P..	W. H. Wyles	W. Stead	Samuel Stead	2/8 to 3/-	2/7½
HARTLEPOOL (B.)	21,521	Ald. R. H. Rowe, J.P.	H. W. Bell	H. C. Crummack ...	H. C. Crummack ...	2/6	2/3
HARWICH (B.) .. ..*L.A 92*	8,191	Ald. W. Groom	A. J. H. Ward.....	.....	H. Ditcham.....	4/3	60/-
HASLINGDEN (B.)	18,225	T. B. Hamilton	W. Musgrove	... ..	R. Taylor.....	3/4 & 3/7	3/-
HAVERFORDWEST (B.) ..... *g*	6,179	Ald. Stephen Green, J.P.	H. Davies	E. Cousins, C.E.....	J. Gibbon.....	4/6	40/- each.
HEANOR (L.B.)	6,822	R. H. Robinson.....	Frederick Cattle, B.A.	.....	John Holbrook	3/9	3/6
HEBBURN (L.B.)	20,005	James Tennant, J.P....	T. Grieves Mabane...	.....	J. McMillan	2/6	...
HECKMONDWIKE (L.B.)..... *L.A.91*	9,282	Samuel Wood.....	A. Macaulay	.. ...	J. Saville.....	2/6 to 2/10	2/6

L.A. or *C.* indicates that a Provisional Order or License for lighting the district by electricity was obtained by the Local Authority or a Company in the year given; and *g* means that the Local Authority owns the Gas Works.

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PROVINCIAL BOROUGHS AND LOCAL BOARDS—*continued.*

Place.	Population.	Chairman or Mayor.	Clerk.	Engineer.	Surveyor.	Price of Gas. Prvte. Consmrs.	Price of Gas. Pub. Lamps
Hendon (L.B.)	14,500	H. Lovejoy	S. Tilley	.....	S. S. Grimley	4/9	...
Hereford (B.) *g*	20,267	E. E. Bosley	Joseph Carless, jun...	W. Parlby, C.E.	J. Parker, C.E.	3/3 to 3/6	67/8 each.
Hertford (B.) *L.A.91*	9,023	Alfred Baker	C. E. Longmore	W. H. Wilds	T. A. Dickinson	4/6	4/6
Heston and Isleworth (L.B.)	26,271	Sir G. S. Measom, J.P.	H. R. Peake	W. B. Bromley, C.E.	W. B. Bromley C.E.	2/10	2/8
Heywood (B.) *g*	23,185	Ald. J. Lawton	A. B. Pilling	J. Diggle, C.E.	J. Diggle, C.E.	2/11 & 3/4	3/4
High Wycombe (B.)	13,435	C. T. Baines	D. Clarke	.....	John Bowen	4/-	60/- each.
Hinckley (L.B.) *g*	7,673	Thomas Ancott	F. S. Preston	.. ...	W. W. Cooper	3/3 to 4/6	3/3
Hindley (L.B.) *g*	14,973	James M. Ashurst	Stephen Holt	.....	A. Holder	3/4	3/4
Hitchin (L.B.)	8,860	William Ransom	W. O. Times	.....	W. A. Lloyd	3/3	22/4
Holmfirth (L.B.)	8,888	Frederick Wood	Harry Lomax	.....	J. C. Barraclough	3/4	3/4
Holyhead (L.B.)	8,680	Samuel J. Griffith	John L. Griffith	.....	Rees Lloyd Davies	3/- to 4/9	4/9
Hornsey (L.B.)	48,500	H. R. Williams	F. D. Askey	T. de Courcy Meade.	T. de Courcy Meade.	3/1 and 3/4	51/8 each.
Horsham (L.B.	8,637	Edward I. Bostock	W. H. Sadler	.....	George Pullen	4/2	4/2
Hove (I.C.) *C.93 (L.A.90)*	27,000	G. B. Woodruff	H. Endacott	H. H. Scott	H. H. Scott	2/9 to 4/9	...
Hucknall Torkard (L.B.)	13,004	Andrew Radford	Parker Woodward	William Swann	William Swann	...	...
Hyde (B.)	31,682	John Oldham	George Stevens	.....	J. Mitchell	3/6	2/11
Idle (L.B.)	6,643	W. H. Vint	N. Jowett	.....	F. Naylor	2/10 & 3/1	2/10
Ilford (L.B.)	7,995	E. J. Beal	J. W. Benton	.....	Peter Watkins	4/8	82/6 each.
Ilfracombe (L.B.)	6,255	C. Darbyshire	F. Brede	.....	O. M. Prouse	3/7 & 3/9	3/7
Ilkeston (B.) *g*	19,744	Ald. F. Sudbury, J.P.	Wright Lissett	F. C. Humphrys	H. J. Kilford	2/7 to 3/1	2/7
Ince (L.B.)	19,800	C. Gidlow Jackson	W. Thistlethwaite	R. Winstanley	R. Winstanley	3/1	...
Jarrow (B.)	33,682	Thomas Renton	W. S. Daglish	J. Petree	J. Petree	2/3	...
Kearsley (L.B.)	7,993	J. W. Watkinson	T. A. Martin	.....	Thomas Nuttall	3/4	2/8
Keighley (B.) *g*	30,811	S. Paget	Geo. Burr	John Laycock	W. H. Hopkinson	2/3 to 2/4½	40/- each.
Kendal (B.)	14,430	Ald. W. Bindloss	J. Bolton	.....	D. Goddard	3/6	36/- each.
Kettering (L.B.)	20,000	J. T. Stockburne	H. Lamb	T. R. Smith	T. R. Smith	3/2	3/2
Kidderminster (B.) *L.A.91*	24,803	Michael Tomkinson	J. Morton	A. Comber	A. Comber	2/5 to 2/7	58/- each.
King's Lynn (B.)	18,265	Ald. W. S. V. Miles	T. G. Archer	E. J. Silcock	E. J. Silcock	3/-	57/6 each.
Kingston-upon-Thames (B.) *L.A.91*	27,059	William Allard	H. A. Winser	H. Macaulay	H. Macaulay	3/2	72/- each.
Lancaster (B.) *L.A.90, g*	31,038	W. Gilchrist	W. O. Roper	J. Cook	J. Cook	2/3	2/3
Leamington (B.)	26,930	Ald. S. Flavel, J.P.	H. C. Passman	W. de Normanville	W. de Normanville	2/6 to 3/-	2/5
Leek (I.C.) *g*	14,128	John Brealey	C. Henshaw	W. H. T. Norfolk	W. Haynes	2/5	Free.
Leigh (Lancs.) (L.B.) *g*	28,702	James Thorp	G. Dickinson	A. T. Fletcher	G. Dickinson	2/9 to 3/3	2/9
Levenshulme (L.B.)	6,000	John Parker	Joseph Hardicker	.....	J. H. Maybury	...	...
Lewes (B.)	11,000	Ald. Edward Hillman.	Mont. S. Blaker, B.A.	.....	T. W. Franks	3/10	3/6
Leyton (L.B.)	70,000	J. Gallaher	R Vincent	W. Dawson	W. Dawson	3/2 and 4/6	78/6 & 87/6
Lichfield (B.)	7,864	John Gilbert	J. H. Hodson	.....	C. J. Corrie	3/4 to 4/4	36/- each
Littleborough (L.B.)	10,878	Alfred J. Law	G. H. Wild	G. H. Wild	G. H. Wild	2/8 to 3/1	2/8
Liversedge (L.B.)	12,743	H. Heaton	T. Mitcheson	Chas. Gott, C.E.	G. Horsfall	...	...

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LLANELLY (L.B.) *L.A.91*	23,805	J. A. Jones..	J. Jennings	.....	G. Watkeys, C.E. ...	3/4 to 4/2	73/9 each.
LOFTUS (L.B.)	6,699	G. H. Anderson.....	G. B. Jackson	.....	T. H. Tarbitt	...	...
LONGTON (B.) ..... *g*	34,327	J. Lorenzo Johnson ...	G. C. Kent	J. W. Wardle	J. W. Wardle	4/11	3/-
LOUGHBOROUGH (B.).....	18,196	Ald. W. A. Cartwright	J. Jarratt	.....	A. W. Cross.....	5/10	2/3
LOUTH (B.)..... ...	10,040	Ald. B. Longbottom...	T. F. Allison	.....	T. Rowland	3/-	4/2
LOWESTOFT (B.)	23,347	A. G. Nottley.....	R. B Nicholson	.....	G. H. Hamby	4/2	3/8
LUTON (B.)	30,005	Asher Hucklesby	G. Bailey.....	T. R. Roscoe	T. R. Roscoe	2/9	47/7 each.
MACCLESFIELD (B.)..... *g*	36,009	Ald. John Fountain ...	W. F. Taylor	J. G. Newbigging ...	E. E. Adshead	2/10	2/6
MAIDENHEAD (B.)	10,607	William Withnall.....	John Kick	.. ...	T. Nash	3/9 and 4/-	3/9
MAIDSTONE (B.) *L.A.92*	32,150	R. A. H. Seymour.....	H. Monckton	W. G. Scoones	W. G. Scoones.....	2/5	2/5
MALVERN (L.B.) ..... *L.A.90, g*	5,846	William Grundy	W. Lambert	.....	J. E. Palmer	4/-	4/-
MANSFIELD (B.) ..... *g*	15,925	Ald. George Pickard...	R. J. Parsons	.....	R. F. Vallance	3/- to 3/6	40/- each.
MARGATE (B.)	18,419	E. S. Wootton	G. Foord-Kelcey	A. Latham, C.E.....	A. Latham, C.E.	3/1	3/-
MERTHYR TYDFIL (L.B.)	58,080	T. Williams, J.P.	G. C. James	T. F. Harvey, C.E.	T. F. Harvey, C.E....	2/8 to 3/8	65/- & 85/-
MIDDLETON (B.) .... *g*	21,310	Ald. James Jones, J.P.	F. Entwistle	T. Duxbury	W. Welburn	3/- to 3/4	3/-
MILNROW (L.B.)	8,640	John Chadwick	Henry Blackburn ...	.....	Charles Rothwell ...	3/1 to 3/9	3/1
MIRFIELD (L.B.)	11,508	Joshua Milner	Edward B. Wilson...	.....	F. H. Hare	3/3	3/3
MORECAMBE (L.B.) *C.90*	6,476	William Aspden	William Tilly	.....	John Bond	3/- to 3/11	3/-
MORLEY (B.)	21,043	Samuel Stockdale	R. Borrough Hopkins	.....	M. Harold Sykes.....	2/6	31/10 each
MOSSLEY (B.).....	14,162	Edward Iredale	J. Hyde	.....	J. Haynes.....	3/- & 3/2	3/-
MOSS SIDE (L.B.) *C.90*	25,000	William Leek.....	H. T. Crofton	John Bowden, C.E.	W.R.Acton, A.M.I.C.E.	3/-	3/9 each
MOUNTAIN ASH (L.B.).....	17,495	Ald. G. Jones.....	H. P. Linton	.....	John Williams	4/- & 4/6	4/6
MUCH WENLOCK (B.)	15,703	Ald. J. Bodanham.....	G. C. Cooper	.....	G. Stevenson	6/3 to 7/6	40/- each
NANTWICH (L.B.).....	7,495	William Harvey...	A. E. Whittingham..	.....	W. S. Williamson ...	3/9	3/9
NANTYGLO AND BLAINA (L.B.)	12,360	John Dakers	J. A. Shepard.....	George Stephens.....	George Stephens.....	...	...
NEATH (B.) ..... *g*	11,113	David Ll. Davies, M.B.	E. C. Curtis	D.M.Jenkins, A.M.I.C.E.	D.M.Jenkins, A.M.I.C.E.	3/4	80/- each
NELSON (B) .... *L.A.83, g*	22,700	Ald. William Hartley	R. M. Prescott	J. W. Bradley.....	J. W. Bradley.....	2/9	2/6
NEWARK-UPON-TRENT (B.).....	14,475	W. Doudleday	G. Tallents	G. Sheppard	G. Sheppard	2/9	2/2 ea 100hr
NEWBURY (B.) ..... *L.A.92, g*	11,002	Joseph Elliott..	H. Burke Godwin ...	.....	E. A. Stickland	4/6	65/- each
NEWCASTLE-UNDER-LYME (B.)..... *g*	18,452	Ald. Samuel Hyslop...	Joseph Griffith	.....	J. Pattison	3/-	59/- each
NEWMARKET (L.B.)..... .....*C.93*	7,000	.....	James Button.....	.....	J. W. Metcalf.....	4/2	3/- ea. 100hr
NEWPORT (I.W.) (B.)	10,216	Francis Pittis, J.P. ...	A. Sotheron-Estcourt,	R. Brierley, C.E. ...	F. W. B. Waterworth	3/9	57/- each
NEWTON-IN-MAKERFIELD (I.C.) ...*g*	12,861	J. W. Emmett	R. Brierley, C.E. ...	.....	R. Brierley, C.E. ...	2/2 & 2/3	2/3
NEWTOWN & LLANLLWCHAIARN (L.B.)	6,610	Capt. E. Pryce-Jones...	William Cooke	.....	R. W. Davies	4/1 & 4/5	4/1
NORMANBY (L.B.)	9,128	Dr. James Glen	Samuel Spry	.....	J. Bulmer	...	...
NORMANTON (L.B.)	8,030	George Earle	C. B. L. Fernandes .	Percival Ross	Alan Irvine.....	3/- to 3/7	3/7
NORTH BIERLEY (L.B.)	22,178	Jon. H. Breaks	W. H. Clough.....	.....	Percival Ross	2/6 to 3/4	2/6
NORTHFLEET (L.B.).....	8,790	R. A. Gibbons	G. E. Sharland and C. E. Hatten	H. Bancroft, C.E. ...	S. Honeycombe	4/9	4/6
NORTHWICH (L.B.)	15,900	John Weston	James Cowley.....	.....	John Brooks	4/2	4/2
NUNEATON & CHILVERS COTON (L.B.)	15,145	Ezekiel Haddon.....	John H. Bland	.....	J. S. Pickering	3/6 to 4/-	57/6

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PROVINCIAL BOROUGHS AND LOCAL BOARDS—*continued.*

Place.	Population.	Chairman or Mayor.	Clerk.	Engineer.	Surveyor.	Price of Gas. Prvte. Consmrs.	Pub. Lamps
Ogmore and Garw (L.B.) *C.92 (Lic.)*	,893	J. B. Jenkins	S. H. Stockwood..	.....	H. D. Williams	...	...
Oldbury (L.B.) .. *g*	18,841	Alfred Thompson	W. Shakespeare	.. ..	H. Richardson	2/9 to 3/1	73/6 each
Ormesby (L.B.)	8,629	Tom Westgarth	S. Spry	.. ..	H. T. Hopper	...	...
Ormskirk (L.B.)	6,651	H. Riding	Fred. C. Hill	.....	R. C. Ivy	3/9	3/–
Ossett (B.)	10,984	Edward Clay	W. Brock	.....	W. Hirst	2/9	2/9
Oswaldtwistle (L.B.) *g*	13,296	R. Reddish	W. Sandeman	.....	R. N. Hunter	2/6	2/6
Oswestry (B.)	8,496	E. Bremner Smith	J. Parry-Jones	.....	J. Bolton	2/10 to 3/11½	60/– each.
Otley (L.B.)	6,806	T. A. Duncan	H. J. Newstead	.....	Samuel Trow	3/9	2/6
Ovenden (L.B.)	7,487	R. Brenard	Horace E. Foster	.....	Joseph Nicholl	...	..
Padiham and Hapton (L.B.) *g*	11,311	Elisha Ingham	J. R. Smith	.....	John Gregson	3/-	2/7 ea. 100 hrs.
Pemberton (L.B.)	18,400	R. Clayton	P. Partington	G. Heaton, A.M.I.C.E.	G. Heaton, A.M.I.C.E.	2/10 to 3/4	...
Pembroke (B.)	14,978	Dr. W. B. Wall	W. O. Hulm	.....	Wm. Thomas	3/9	49/2 ea 9 mos
Penarth (L.B.)	12,000	D. Morgan	J. W. Morris	Jas. Court	Jas. Court	2/6	..
Penrith (L.B.) *g*	8,981	B. Sweeten	G. Wainwright	.....	Thomas Pollock	2/10	2/9
Penzance (B.)	12,432	Ald. W. H. Julyan	T. H. Cornish	.....	G. H. Small	4/6	...
Peterborough (B.)	25,172	W. D. Nichols, J.P.	W. Mellows	J. C. Gill, C.E.	J. W. Walshaw	3/2 & 3/4	3/2
Pontefract (B.)	9,702	Ald. Joseph Taylor	J. W. Sangster	.....	J. Heseltine	3/–	3/–
Pontypool (L.B.) *C.93 (Lic.)*	8,000	.....	E. Jones	.....	J. Powell	3/6 to 4/3	3/9
Pontypridd (L.B.)	12,317	Rev. D. W. Williams.	H. L. Grover	.....	Edward Rees	3/2 & 4/2	75/– each.
Poole (B.) *C.90, 91*	15,405	F. G. Wheatley	H. Salter Dickinson	.....	J. Elford, M.S.A.	4/6	3/6
Portland (L.B.)	9,541	Edward J. Pearce	Sir R. N. Howard	J. L. Webster, C.E.	J. L. Webster, C.E.	5/–	...
Prescot (L.B.)	6,419	Castle Spencely	Henry Cross	.....	W. Goldsworth	4/8	4/6
Prestwich (L.B.)	8,627	John Cottrill	A. W. Grundy	.....	William Peel	...	...
Pudsey (L.B.)	13,444	Simeon Myers	B. Dufton	.....	R. Hodgson	2/9	2/9
Queensbury (L.B.)	6,824	John Sherwin	J. Richardson	.....	Rufus Smith	...	...
Radcliffe (L.B.)	20,020	Samuel Walker	James Sharples	.....	W. L. Rothwell	3/4 to 3/10	3/4 to 3/10
Ramsbottom (L.B.)	16,700	E. Cunliffe	John W. Barlow	.....	Arthur W. Smith	3/4 to 3/9	3/4
Ramsgate (B.) *g*	24,733	Ald. W. P. Blackburn.	W. A. Hubbard	W. A. Valon	W. Oxtoby	2/8	2/8
Rastrick (L.B.)	9,279	W. C. Holmes	C. E. Shackleton	.....	C. E. Shackleton	2/6 to 2/11	2/6 to 2/11
Rawmarsh (L.B.)	12,000	E. Bawforth	J. W. Bellamy	.....	J. W. Wetherill	3/– & 3/3	70/– each.
Rawtenstall (L.B.)	29,176	Wm. Lord	T. Woodcock	.....	Henry A. Cutler	3/7	...
Redditch (L.B.)	9,961	T. H. Harper	H. C. Browning	.....	J. F. Thorrold	3/11	3/11
Redruth (L.B)	9,335	Alfred Lanyon	Henry Paige	.....	R. James	4/6	...
Reigate (B.)	22,639	Ald. W. Brown	C. J. Grece, LL.D.	F. D. Clark, M.I.C.E.	F. D. Clark, M.I.C.E.	4/–	69/– each.
Retford (B.) *g*	10,603	John Henry Hewitt	Samuel Jones	.....	J. D. Kennedy	3/4	5/8 d. ea pr hr
Rhymney (L.B.)	7,733	H. V. Trump	Ll. Reynolds	.....	W. L. Marks	4/–	50/- & 63/- ea
Richmond (Surrey) (B.) *L.A.83*	22,500	Ald. J. W. Szlumper	F. B. Senior	.....	E.J. Lovegrove, A.M.I.C.E	3/3 & 3/9	75/– each.
Ripon (B.) *g*	7,512	Ald. F. Smith, J.P.	Matthew Kirkley	Francis Shepherd (Gas)	William Edson	3/6	45/– & 60/–
Rochester (B.) *C.90*	26,309	E. W. Willis	R. Prall	.....	W. Banks	2/1 & 2/6	1/5

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ROMFORD (L.B.)	7,176	Thomas Bird	A. H. Hunt	.....	Jonas Turvey	4/2 & 4/6	75/- & 80/-
ROTHERHAM (B.) *g*	45,000	Ald. G. Wragg, J.P.	H. H. Hickmott	.....	Geo. Jennings	2/3 to 2/9	Free.
ROWLEY REGIS (L.B.)	30,790	Walter Bassano	A. Wright	.....	W. H. Brettel, C.E.	3/3 & 3/9	50/- each.
ROYTON (L.B.)	13,395	J. Waterworth	T. Bleasdale	.....	T. Bleasdale	2/4	...
RUGBY (L.B.)	9,891	Rev. Charles Elsee	T. M. Wratislaw	.....	J. H. Brierley	3/- & 3/6	45/- each.
RUNCORN (I.C.)	19,629	Henry I. Grice	E. Marshall	.....	M. Barker	2/10 & 3/2	42/ea10mos
RYDE (B.)	10,927	Benj. Whittington	C. H. Collis	F. Newman	F. Newman	3/6	3/6
ST. ALBAN'S (B.)	12,895	Albert Rowden	A. H. Debenham	.....	G. Ford	3/2	2/10
ST. AUSTELL (L.B.) *C.85*	3,582	Walter Hicks	E. Carlyon	.....	J. Samble	4/6	4/6
ST. GEORGE (L.B.)	34,396	Alfred Lovell	J. Stubbs	.....	T. L. Lewis	2/10	2/10
ST. IVES (Cornwall) (B.)	6,094	Ald. John Roach	Edward Boase	.....	John Grenfell	6/8	5/6
SALE (L.B.)	9,644	Thomas Kirkley	Henry Dixon	A. G. McBeath	A. G. McBeath	3/2	3/-
SALISBURY (B.)	15,533	Charles Haskins	W. C. Powning	J. C. Bothams	J. C. Bothams	3/4	2/9
SCARBOROUGH (B.) *L.A 91*	33,776	G. L. Beeforth, J.P.	J. E. T. Graham	J. Petch	J. Petch	3/-	19/6
SEAHAM HARBOUR (L.B.)	7,714	J. B. Eminson	H. B. Wright	.....	James Burrell	3/6	3/6
SEDGLEY (L.B.)	14,874	Stephen Wilkes	J. Smith	Geo. Hancock	B. Hughes	3/3 to 3/6	...
SEVENOAKS (L.B.)	7,625	M. Lambarde	H. J. Thompson	.....	Jabez Mann, C.E.	3/7 to 4/5	69/8 each.
SHEERNESS (L.B.)	14,286	Edward W. Brightman	V. H. Stallon	.....	W. Wallace Copland	2/4 to 3/-	3/-
SHILDON AND EAST THICKLEY (L.B.)	9,584	William Hill	J. T. Proud	.....	W. A. Mason	...	...
SHIPLEY (L.B.)	15,089	Charles Stead	J. S. Rhodes	.....	W. H. Dawson	2/8	2/10
SHIRLEY AND FREEMANTLE (L.B.)	15,901	W. A. Killby	M. L. Harle	.....	H. J. Weston	3/4	3/4
SHREWSBURY (B.)	26,967	W. Lyon Browne	H. C. Clerke	W. Chapple Eddowes	W. Chapple Eddowes	3/-	60/-ea 3,334hr
SITTINGBOURNE (L.B.)	8,284	F. G. Gibson	W. J. Harris	Edward Easton	W. L. Grant	3/9 & 4/-	67/6 each.
SKELTON AND BROTTON (L.B.)	13,558	E. Hamilton	A. Buchanan	.....	W. P. Robinson	...	...
SKIPTON (L.B.)	10,376	J. B. Dewhurst	R. Wilson	.....	T. Mallinson	2/6 to 2/8½	2/7
SMETHWICK (L.B.) *g*	36,170	John Newey	W. Shakespeare	B. Smith	J. C. Stuart	2/6 to 3/-	67/- each.
SOUTHEND (B.) *L.A.91*	13,000	Ald. D. W. Gossett	W. Gregson	.....	C. T. Copley	4/- & 4/5	42/6 each.
SOUTHGATE (L.B.)	9,500	W. Burrows	W. M. Ellenor	.....	C. G. M. Lawson	...	...
SOUTH HORNSEY (L.B.)	17,000	C. B. Melhuish	E. B. Bennett	.....	W. Jameson	2/6	...
SOUTHPORT (B.) *L.A.91, g*	43,026	James Wood, L.L.D.	J. D. Williams	John Booth	W. Crabtree, M.I.C.E.	2/9 to 4/6	Free.
SOUTHWICK (L.B.)	8,178	Robert Thompson	J. C. Wilford	.....	J. G. Reah	...	...
SOWERBY BRIDGE (L.B.) *g*	10,408	John William Helson	Gdfry. Rhodes & Evans	.....	F. Rothera	2/6 & 3/4	Free.
SPALDING (I.A.) *g*	10,560	Major Shadford	H. H. Harvey	J. G. Hawkins	Daniel Crampton	3/9	58/- each.
STAFFORD (B.) *L.A.90, g*	20,270	George Wormal	M. F. Blakiston	J. F. Bell (Gas)	W. Blacksbaw	2/3 & 2/8	60/- each.
STALYBRIDGE (B.) *g*	26,771	Ald. W. Tinker, J.P.	Noah Buckley	E. A. Loam	Amos Lee	2/8 to 2/10	2/8 to 2/10
STAMFORD (B.)	8,358	Ald. John Hayes	J. E. Atter	.....	Jas. Richardson	3/6	3/-
STAPLETON (L.B.)	14,589	John Hensbaw	Aquila P. Monks	A. J. Saise	A. J. Saise	3/-	2/10
STOCKTON-ON-TEES (B.) *L.A.90,g*	49,731	Wm. C. Langley	M. B. Dodds, M.A.	K. F. Campbell	K. F. Campbell	2/6	2/6
STOKE-ON-TRENT (B.) *g*	24,027	Ald. H. C. Faram	J. B. Ashwell	.....	W. Bowen	2/3 to 3/6	65/- each.
STOURBRIDGE (L.B.)	9,757	C. H. Collis	Harry Mills	.....	W. Fiddian	2/10 to 3/2	40/-& 52/6 ea.
STRATFORD-ON-AVON (B.) *g*	8,313	R. Latimer-Greene	T. Hunt	.....	A. H. Campbell	3/- to 3/6	42/9 each.

L.A. or *C.* indicates that a Provisional Order or License for lighting the district by electricity was obtained by the Local Authority or a Company in the year given; and *g* means that the Local Authority owns the Gas Works.

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PROVINCIAL BOROUGHS AND LOCAL BOARDS—*continued.*

Place.	Population.	Chairman or Mayor.	Clerk.	Engineer.	Surveyor.	Price of Gas. Prvte. Consmrs.	Pub. Lamps.
Stretford (L.B.) *C.90*	21,751	James B. Shaw	Frank Whitworth ...	.....	H. Royle, A.M.I.C.E.	3/2	3/-
Stroud (L.B.)	10,000	James Chew	Percy Witchell	.....	G. P. Milnes	3/2	60/- each.
Surbiton (I.C.) *L.A.91*	9,406	Thomas Guilford	James Bell	.....	Samuel Mather	...	...
Sutton (L.B.) *L.A.92*	14,975	E. Price-Edwards	Thos. D. Pettiver ...	.....	A. D. Greatorex, C.E.	4/3	3/6
Sutton Coldfield (B.)	8,686	Ald. E. T. Walters ...	T. V. Holbeche	.....	C. F. Marston	2/3 to 2/7	...
Sutton-in-Ashfield (L.B.)..... *g*	8,523	F. Tudsbury	G. H. Hibbert.....	.....	McW. Bishop	2/11 to 3/11	40/- each.
Swindon New Town (L.B.)	27,500	H. J. Birch.....	H. Kinneir	.....	H. J. Hamp	3/9	3/6
Swinton (L.B.)	7,612	W. H. Lomax.....	F. L. Harrop	.....	G. J. Monson	3/4 & 3/6	45/- each.
Swinton and Pendlebury (L.B.)	22,000	T. Pollitt	James Berry.....	.....	W. F. Pinfold.....	2/8	...
Taunton (B.) *L.A.93*	18,026	Ald. H. J. Van Trump	T. Meyler.....	J. H. Smith.....	J. H. Smith	3/2½ to 3/9	4/-
Teddington (L. B.)	6,599	A. Frampton	J. J. Staples	.....	H. York	...	...
Teignmouth (L.B.) ..... *g*	8,171	Rev. A. Cartwright ...	W. R. H. Jordan ...	.....	William Curry.....	3/9	3/6
Thornaby-on-Tees (B.).....	15,637	W. Anderson, J.P.....	W. J. Watson	.....	M. Scott	2/8	2/8
Thornhill (L.B.)	8,843	Thomas Turner	J. H. Dyson	.....	J. C. Haller.....	...	...
Tipton (L.B.) ..... *g*	29,316	Daniel Hipkins	G. M. Waring.....	.....	W. H. Jukes	2/3 to 2/9	39/3 ea 8 ms
Tiverton (B.) *L.A.90*	10,892	F. A. Payne, J.P.	C. M. Hole	.....	J. Siddalls	3/11	72/6 each
Todmorden (L.B.)	24,725	Fred. Ashworth	D. Sutcliffe	.....	Herbert Shaw	3/2	3/2
Tonbridge (L.B.)	10,123	Frank East, C.C.	A. H. Neve, jr.	.....	George Hobbs	3/8	3/8
Torquay (B.) *L.A.91*	25,534	J. Peyto C. Shrubb ...	F. S. Hex	.....	H. A. Garrett	3/3	3/3
Tottenham (L.B.)	71,336	Walter Low	E. Crowne	P. E. Murphy..... ..	P. E. Murphy	3/2	62/6 each
Toxteth Park (L.B.)..... *C.91*	21,500	T. T. Wainwright	North, Kirk, & Cornett	.....	J. Price.....	...	...
Tredegar (L.B.) ..... *g*	17,564	James Colquhoun	J. A. Shepard	W. C. Widdowson ...	W. C. Widdowson ...	4/6	4/6
Trowbridge (L.B.).....	11,717	W. P. Clark	T. S. Hill.....	.....	W. H. Stanley	3/4	50/- each.
Truro (B.)	11,131	Ald. T. Chirgwin, J.P.	Robert Dobell.....	.....	W. Clemens.....	3/6½ to 3/9½	70/- each.
Tunbridge Wells (B.) *L.A.91*	27,895	H. H. Cronk	W. C. Cripps	W. Brentnall	W. Brentnall	3/3	3/3
Tunstall (L.B.)	15,730	Charles Pyatt.....	A. P. Llewellyn	.....	A. R. Wood.....	3/-	...
Twickenham (L.B.)	16,026	C. J. Thrupp	W. Ruston	G. B. Laffan	G. B. Laffan.....	3/-	...
Tyldesley and Shakerley (L.B.) *g*	9,954	John Hardman	J. T. G. Cranshaw ...	J. T. G. Cranshaw...	J. T. G. Cranshaw...	3/- to 3/4	28/- each.
Tynemouth (B.)..... *L.A.91*	46,267	Ald. J. F. Spence	H. A. Adamson	J. F. Smillie	J. F. Smillie	2/3 & 2/9	1/- ea. wk.
Ulverston (L.B.) .... *g*	9,940	William Settle	John Poole	.....	Henry Whitlow	3/9	3/9
Uxbridge (L.B.)	7,669	Sir W. H. Stephenson	William Garner	.....	W. L. Eves	4/- and 5/6	4/-
Wakefield (B.)	33,146	Walter Wade.....	C. J. Hudson	.....	R. Porter	2/10	2/10
Walker (L.B.).....	11,341	Thomas Crawford	T. M. Sturgess	.....	T. W. Laycock	2/6 to 3/-	1/- ea. weekly
Wallasey (L.B.) ..... *g*	33,094	Richard Still	W. Danger	H. A. Hill	A. Salmon	3/-	73/- each.
Walthamstow (L.B.)..... ..	46,346	W. B. Whittingham...	G. Houghton	G. W. Holmes	G. W. Holmes..... .	4/6	67/3 each.
Walton-le-Dale (L.B.)	9,286	John Eccles	F. E. Dixon.....	.....	F. E. Dixon, T. Moxham	...	...
Walton-on-the-Hill (L.B.).....	40,304	T. H. Williams	E. Smith	.....	S. Middlebrook	...	...
Warrington (B.) ..... *g*	52,742	Ald. E. Greenall,.....	J. Lyon-Whittle.....	W. S. Haddock	T. Longdin	3/6 to 4/6	40/- each.

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WARWICK (B.)	11,905	Ald. Thomas Kemp	Brabazon Campbell	C. Melville Richards	C. Melville Richards	2/8 to 3/-	54/- each.
WATERLOO-WITH-SEAFORTH (L.B.)	17,328	E. Cannington	M. J. Parry	.....	F. Spencer Yates	3/-	24/- p. 2000 hs.
WATFORD (L.B.)	13,490	Edward J. Shim..	H. M. Turner	.....	D. Waterhouse	3/4	3/4
WAVERTREE (L.B.)	14,764	P.E.G. Hernsluyk, J.P.	R. Mealing	.....	W. H Travers	3/-	...
WEDNESBURY (B.)	25,311	W. H. Lloyd	G. Rose, M.A.	.....	E. M. Scott	...	...
WELLINGBOROUGH (L.B.)	15,068	D. Dulley	J. T. Parker	E. Sharman	E. Sharman	3/- to 4/-	3/2
WELSHPOOL (L.B.)	7,107	Col. G. C. Huddleston.	E. Jones	.....	George Snook	3/4 to 4/2	50/- ea. 9 mos.
WEST COWES (L.B.)	6,721	G. W. H. Warder	H. J. Damant	.....	N. F. Dennis	4/4	54/- each.
WEST DERBY (L.B.)	40,000	William Pye	Layton & Springmann	.....	F. C. Everett	3/4	26/8 p. 2000 hs.
WEST HARTLEPOOL (B.)	42,250	John Suggitt	H. Simpson	J. W. Brown, C.E.	J. W. Brown, C.E.	2/6	2/3
WESTON-SUPER-MARE (L.B.) *L.A.91*	12,894	Spencer Tyler	W. Smith	.....	Hugh Nettleton	3/6	66/4 each.
WEYMOUTH (B.)	13,769	Sir R. N. Howard	P. Hooper	.....	W. B. Morgan	3/10	3/10
WHICKHAM (L.B.)	7,976	Henry Wallace	Thomas Lambert	.....	John Dinsdale	...	...
WHITBY (L.B.) *L.A.91*	13,106	T. N. Marwood	R. E. Pannett	.....	T. K. Scott	3/9	53/6 each.
WHITEFIELD (L.B.)	10,775	Francis Farrar	John P. Monks	Thomas Thorp	William Skinner	4/3	3/7
WHITEHAVEN (L.B.) *L.A.91*	17,812	J. Gibson Dees	J. Collins	J. S. Brodie	J. S. Brodie	3/6	3/-
WHITTINGTON (L.B.)	8,798	George Senior	H. T. Twelves	.....	James Kirk	4/-	...
WHITWORTH (L.B.)	12,000	W. L. Shawforth	Owen March	F. Rodley	F. Rodley	3/4 to 3/9	3/4
WIDNES (B.) *g*	30,011	Ald. F. H. Gossage, J.P.	H. S. Oppenheim	Isaac Car	John S. Sinclair	1/8 & 1/10	...
WILLINGTON (L.B.)	7,238	C. E. Bell	J. G. Wilson	.....	John Cooke	...	...
WILLENHALL (L.B.)	16,067	Isaac Pedley	J. Clark	.....	B. Baker	2/9 to 3/3	50/6 ea. 9 mos.
WILLESDEN (L.B.)	61,266	James Stewart	S. Tilley	O. Claude Robson	O. Claude Robson	3/1	2/2
WIMBLEDON (L.B.) *L.A.89*	25,758	John Townsend	W. H. Whitfield	C. H. Cooper	C. H. Cooper	3/10	...
WINCHESTER (B.)	19,073	Ald. T. Stopher	W. Bailey	.....	W. Gamon	3/6	...
WINDHILL (L.B.)	6,732	John Rodgers	Nathan Jowett	.....	John Pedley	...	...
WINDSOR (B.) *C.90*	12,327	F. A. Layton	George H. Long	.....	T. V. Davison	3/8	60/- each
WINSFORD (L.B.)	10,440	G. Garfitt, J.P.	J. H. Cooke	.....	W. R. Shorrock	5/5	4/6
WISBECH (B.)	9,395	A. W. May	F. Jackson	.....	A. H. Plowright	3/9	60/0 each.
WITHINGTON (L.B.)	25,729	G. H. Gaddum	A. Roberts	.....	A. H. Mountain	3/-	37/- each.
WOLBOROUGH (L.B.)	7,662	W. J. Watts	R. H. M. Baker	.....	Lewis Stevens	...	...
WOMBWELL (L.B.) *g*	11,000	Joseph Mitchell	J. Robinson	.....	J. Robinson	3/3 to 4/-	...
WOODFORD (L.B.)	10,984	Alfred Buck	Robert Martin	.....	C. Mathew	3/- & 4/6	3/- & 54/- ea
WOOD GREEN (L.B.)	27,000	R.D.M. Littler, C.B., Q.C.	J. W. Britton	.....	C. J. Gunyon	3/2	62/6 each.
WORKINGTON (B.) *g*	23,522	J. Duffield	J. Warwick	J. Johnston	W. L. Eaglesfield	2/6	35/- each.
WORKSOP (L.B.)	11,625	W. J. Moore	J. Appleton	O. Harrison	O. Harrison	3/6	45/6 each.
WORSBOROUGH (L.B.)	9,905	F. G. Robinson	Alfred Clegg	.....	J. Whitaker	...	...
WORTHING (B.)	16,606	Ald. R. Piper	W. Verrall	.....	Miles Aspinall	3/9	3/6
WREXHAM (B.) *C.90*	12,500	Ald. R. H. Done	T. Bury	.....	J. W. M. Smith	3/6 to 4/6	3/6 to 4/6
YEADON (L.B.)	6,534	W. Barrett	H. Walmsley	.....	I. Wood	3/9 to 4/2	3/9
YEOVIL (B.)	10,943	Sidney Watts	H. B. Batten	.....	W. K. L. Armytage	3/6	46/3 each.
YSTRADYFODWG (L.B.)	88,380	W. Jenkins	W. H. Morgan	.....	W. J. Jones	3/3 to 4/6	4/3

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SCOTCH BURGHS, &c

Place.	Population.	*Lord Provost, Provost or Chairman.	Town Clerk.	Engineer.	Surveyor.	Price of Gas. Prvte. Consmrs.	Pub. Lamps.
Aberdeen (B.) ..... g	110,173	*Hon. David Stewart..	W. Gordon	.....	W. Dyack	3/11	3/11
Airdrie (B.)	15,133	George Arthur	J. Chapman	.....	John Chalmers	3/9	12/6, 8 mos.
Alloa ..... g	...	... ..	.....	.....	.....	3/4	3/4
Arbroath (B.)	22,960	G. Keith	W. K. Macdonald ...	.....	William Stewart.....	4/7	28/-
Ayr (B.)	24.800	Robert Shankland.....	A. G. Young	.....	.....	4/2	4/2
Banff (B.)	7 578	James Smith	J. Allan	.....	.....	6/3	21/-
Blantyre	...	.. ...	.....	.....	.. ...	4/2	...
Brechin (B.)	8,955	W. M. Vallentine	James Craig	.....	William Eggie.....	4/7	4/7
Broughty Ferry.....	...	.....	.....	.....	.....	4/2	free
Campbeltown (B.)	8,235	John M'Kersie	D. Mactaggart.....	.....	.....	4/2	4/2
Coatbridge	30,033	John Alexander.....	John McAlston	C. Young	C. Young	3/9	25/6
Dalkeith	...	.....	... ..	. ...	.....	4/-	4/-
Dumbarton (B.)..... g	17,836	Robert Blair	A. Roberts	.....	William Young	3/3	2/9
Dumfries (B.)..... g	16,673	John Luke Scott	John Grierson.....	.....	.....	3/6	3/6
Dundee (B.) ..... g	142,455	*Hon. A. Mathewson...	D. Thornton	William Mackison ...	William Mackison ...	3/8	3/5½
Dunfermline (B.)	22,635	James Walls	J. Landale	.....	.....	5/5	3/9
Dysart (B.)	12,849	A. Terrace	T. Dow.....	.....	.....	4/10	4/10
Edinburgh (B.) ..... g	261,261	*Rt. Hon. J. A. Russell	W. Skinner, F.R.S.E.	.....	.....	4/6	3/6
Elgin (B.)	7,799	*William Law	Hugh Stewart.....	William Taylor	William Taylor	5/5	5/5
Falkirk (B.)	17,307	A. Griffiths..... ..	J. Wilson.....	.....	.....	3/4 to 3/9	3/4
Forfar (B.) ..... g	12,844	William Doig.....	J. Taylor.....	.....	J. Harris	4/-	4/6
Galashiels (B.)	17,249	Andrew Brown	Richard Lees	.....	John Murray	3/9	3/9
Glasgow (B.) ..... *L.A.92*, g	789,000	James Bell	Sir J.D.Marwick, LL.D.	William Arnot (*Elec.*)	A. B. M'Donald	2/6	2/6
Greenock (B.) ..... g	63,816	Dugald Shankland ...	C. MacCulloch	.....	James Wilson.....	3/4	3/4
Hamilton (B.) .... g	25,300	John Wylie.....	W. Pollok & P. M. Kirk-	.....	Robert Watson	2/11	2/11
Hawick (B.).....	19,204	Walter Scott Barrie ...	R. Purdom.. [patrick	.....	John Manuel	3/11½	3/11½
Inverness (B.) ..... g	19,214	Alexander Ross	K. Macdonald.....	.....	.....	5/-	4/7
Irvine (B.)	9,037	James Armour	J. Dickie	.....	... ..	3/9	18/-
Johnstone ..... g	9, 695	George Thomson	William Reid	.....	.....	4/4½	4/4½
Kilmarnock (B.) ..... g	28,438	A. McLelland.....	W. Middlemass	.....	.....	3/4	12/-
Kirkcaldy (B.)	27,151	Thomas Black	W. R. Spears	.....	W. D. Sang.....	3/6½	3/6½
Kirkintilloch ..... g	12,426	John Aitken	David Patrick..	William Marshall ...	.....	4/6	4/-
Leith (B.) ..... g	60,843	Thomas Aitken	T. B. Laing.....	.....	.....	4/6	3/6
Montrose (B.)	12,885	James Mitchell	D. C. Wills.....	.....	.....	4/7	11/-1000hs
Musselburgh (B.)	8,885	P. Keir	A. D. Macfarlane ...	.....	.....	4/5	3/9
Paisley (B.) ..... g	66,420	John McGown	Young and Martin...	.....	J. W. Moneur	2/10	2/2
Partick (B.)..... *L.A.93*	42,360	James Caird	James Donaldson ...	.....	Joseph Potts	2/6	2/6
Perth (B.) ..... g	29,902	*Hon. G. Wilson	W. MacLeish	.....	.....	4/-	4/-
Peterhead (B.) ..... g	12,195	John Smith.....	A. Robertson	.....	.....	5/10	5/10

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PORT GLASGOW (B.) ..... *g*	14,624	A. Gray	D. R. Maclelland ..	.....	.....	4/2	35/ & 40/ ea.
PORTOBELLO (B.)	8,181	Thomas Wood..... ..	R. P. Stevenson	.....	John Hopkirk.....	4/9	4/9
RENFREW (B.)..... ..... *g*	6,246	Andrew Brown	W. Herron	.....	Gilbert Deans	4/2	37/- each
ROTHESAY (B.) ..... *g*	9,034	L. Milloy	J. T. Wilson	.....	John Morrison.....	3/9	3/-
RUTHERGLEN (B.)..... ...	13,361	Robert Leing	G. Gray	.....	.....	...	...
ST. ANDREWS (B.)	6,853	John Paterson	S. Grace	.....	.....	3/7	11/6 each
SELKIRK (B.).....	5,788	T. Craig-Brown	John Pollock	.....	.....	4/2	28/- each
STIRLING (B.)	16,895	G. Kinross	T. L. Galbraith	.....	William Ronald	3/11	...
STRANRAER (B.)	6,171	W. M. MacRobert.	W. Black.....	.....	.....	5/-	5/-
WICK (B.)	8,463	C. Durrant	H. Sutherland.....	.....	.....	6/8	...

IRISH BOROUGHS AND TOWN COMMISSIONS.

PLACE.	Population.	Mayor or Chairman.	Town Clerk or Clerk.	Engineer.	Surveyor.	Price of Gas. Prvte. Consmrs.	Pub. Lamps
ARMAGH (T.C.)	...	.....	.....	.....	.....	3/6 and 4/2	3/6
BALLYMENA (T.C.)	10,000	S. J. M'Cartney, J.P...	Henry O'Hara.....	.....	Henry O'Hara.....	4/7	35/- ea.
BELFAST (B.)	255,896	Sir D. Dixon ...(*L.M.*)	Sir S. Black	.....	J. C. Bretland.....	2/9	52/6 ea.
BRAY (T.C.)	6,539	H. Vincent Jackson...	P. MacDonnell	P. F. Comber	P. F. Comber	4/6	4/6
CARLOW (T.C.)	6,900	Michael Governey	James Kelly	.....	James Byrne	5/-	Electricity.
CLONMEL (B.)	8,480	Ald. J. H. Lonergan, J.P.	J. F. O'Brien	.....	S. A. Brunicardi ...	5/-	54/-
CORK (B.)	80,124	Ald. A. Roche	A. McCarthy	.....	.....	2/11 to 3/9	3/7
DROGHEDA (B.).....	12,279	Capt. Branigan	P. Connolly.....	.....	Nicholas Hatch	4/6	4/4
DUBLIN (B.) *L.A.92*	252,239	Ald. V. B. Dillon (*L.M.*)	H. Campbell	.....	Spencer Harty	3/7 to 3/10	3/7 & 3/10
DUNDALK (T.C.)	...	.....	.....	.....	.....	4/2 & 4/7	48/- ea.
KILKENNY (B.).....*L.A.92*	11,024	Cornelius Quinn.....	C. J. Kenealy.....	.....	.....	...	...
LARNE (T.C.).....	6,000	James Foster	William Baxter	— Turner	.....	4/7	38/6 ea.
LIMERICK (B.) *L.A.92,g*	38,562	Bryan O'Donnell	.....	.....	.....	4/9	70/- & 80/- ea.
LONDONDERRY (B.).....	33,728	J. Acheson-MacCullagh	R. N. Chambers.....	Henry W. Blake ...	W. J. Robinson	3/10	65/- ea.
NEWRY (T.C.).....*g*	13,603	James MacMahon	Robt. H. Doherty ...	J. L. D. Meares	J. L. D. Meares	4/7	45/- ea.
QUEENSTOWN (T.C.).....	...	.....	.....	.....	.....	5/-	60/- ea.
SLIGO (B.)	11,000	F. Higgins	D. McGill	.....	.....	3/7 & 5/5	4/6
WATERFORD (B.).....*L.A.92*	22,457	Ald. J. Manning	— Feely	.....	M. J. Fleming.....	5/-	57/6 each.
WEXFORD (B.)	12,163	Capt. H. McGuire	W. A. Browne.....	.....	.....	3/-	50/- & 60/- ea.

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PRINCIPAL BRITISH RAILWAYS.—CHIEF OFFICIALS.

(*For* TELEGRAPH ENGINEERS *see next page.*)

Railway.	*Offices.*	*General Manager.*	*Secretary.*	*Chief Engineer.*	*Stores Superintendent.*
Belfast and County Down	Queen's Quay, Belfast	J. Pinion	John Milliken	G. P. Culverwell, C.E.	....
Belfast and Northern Counties	York-road Terminus, Belfast	Ed. J. Cotton	W. R. Gill	B. D. Wise	Alex. Ellis
Brecon and Merthyr Tydfil Junctn.	132, Palmerston-buildings, Old Broad-street, London, E.C.	Alfred Henshaw (Newport, Mon.).	H. R. Price	C. H. Thomas, (Newport, Mon.).	W. H. Richardson (Brecon).
Caledonian	302, Buchanan-street, Glasgow	James Thompson	John Blackburn	Geo. Graham, C.E.	James Lorimer
Cambrian	Oswestry, Salop	A. Aslett	A. Aslett	George Owen, C.E.	T. S. Goldsworthy
Cheshire Lines	Central Station, Liverpool	D. Meldrum	Glegge Thomas	W. G. Scott	S. Saxon Barton
City and South London	46, King William-st., London, E.C.	Thos. C. Jenkin	W. F. Knight	Basil Mott	....
Cork, Bandon and South Coast	Albert Quay, Cork	....	R. H. Leslie	John R. Kerr, C.E.	....
Dublin, Wicklow and Wexford	Westland-row, Dublin	W. L. Payne	E. W. Maunsell	J. C. Smith, C.E. (Bray)	....
Eastern and Midlands	17, Victoria-street, London, S.W.	Robert A. Read	Edward B. Read	W. Marriott	....
Furness	Barrow	Henry Cook	Henry Cook	F. Stileman (23, Gt.	George-street, S.W.)
Glasgow and South-Western	St. Enoch Station, Glasgow	Thomas Brunton	F. Gillies	William Melville	Andrew Lindsay
Great Eastern	Liverpool-street, London, E.C.	W. Birt	T. D. Genlloud	J. Wilson	(Stratford)
Great Northern	King's Cross, London, N.	Sir Henry Oakley	William Latta	Richard Johnson	J. Martin (Doncaster)
Great Northern of Ireland	Amiens-street, Dublin	T. Robertson	H. Plews	W. H. Mills	....
Great Northern of Scotland	Aberdeen	W. Moffatt	W. Moffatt	P. M. Barnett, C.E.	....
Gt. Southern & Western (Ireland)	Kingsbridge, Dublin	R. G. Colhoun (Traf.)	Francis B. Ormsby	Kennett Bayley	C. R. Riley
Great Western	Paddington Station, London, W.	H. Lambert	G. K. Mills	J. C. Inglis	W. A. Stanier (Swin-
Highland	Inverness	Andrew Dougall	Andrew Dougall	Murdoch Paterson	J. G. Bulmer [don)
Hull, Barnsley & W. Riding Junc.	Charlotte-street, Hull	V. W. Hill	J. Daniell	R. Pawley	C. Walker
Lancashire and Yorkshire	Hunt's Bank, Manchester	J. H. Stafford	C. W. Bayley	William Hunt	E. Prentis
London and North-Western	Euston Station, London, N.W.	F. Harrison	T. Houghton	F. Stevenson	....
London and South-Western	Waterloo Station, London, S.E.	C. Scotter	F. J. Macaulay	E. Andrews	G.R.Barrell, NineElms
London, Brighton & South Coast	London Bridge Terminus, S.E.	Allen Sarle	Allen Sarle	F. D. Banister	E.Trangmar(N.Cross)
London, Chatham and Dover	Victoria Station, London, S.W.	W. Forbes (Traf.)	John Morgan	G. B. Roche	J. Ward
London, Tilbury and Southend	Fenchurch-st. Stn., London, E.C.	A. L. Stride (M. Dir.)	H. Cecil Newton	....	....
Manchester, Sheffield and Lincoln.	London-road, Manchester	William Pollitt	Oliver S. Holt	Alexander Ross	A. W. Longden
Metropolitan	32, Westbourne-ter., London, W.	John Bell	G. H. Whissell	....	....
Metropolitan District	Victoria-street, London, S.W.	Alfred Powell	Wm. Jones	Geo. Estall	....
Midland	Derby	Geo. H. Turner	J. Williams	J. A. McDonald	J. Pettifor
Midland and S. Western Junction	Swindon	Sam Fay	Sam Fay	J. R. Shopland	....
Midland Great Western of Ireland	Broadstone, Dublin	Joseph Tatlow (Traf.)	G. W. Greene	A. Smythe & W. O'Neill	M. A. Storen
North British	Edinburgh	John Conacher	John Cathles	James Carswell	J. J. Smith
North-Eastern	York	George S. Gibb	C. N. Wilkinson	....	E. H. Clark (Gateshd.)
North London	Broad-street, London, E.C.	G. Bolland Newton	G. Bolland Newton	T. Matthews	....
North Staffordshire	Stoke-on-Trent	W. D. Phillipps	Percy Morris	G. J. Crosbie-Dawson	J. F. Green
South-Eastern	London Bridge Station, S.E.	Sir Myles Fenton	William R. Stevens	F. Brady	Joseph Barnes
Taff Vale	Cardiff	A. Beasley	J. Jones	J. W. Brewer	W. Bevan
Waterford and Central Ireland	Waterford	J. D. Nott	J. D. Nott	Chas. R. Galwey	....
Waterford and Limerick	Waterford	F. Vaughan (Limerick)	J. J. Murphy	J. Tighe	....

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BRITISH RAILWAYS' TELEGRAPH ENGINEERS.

Railway.	Telegraph Engineer.	Office.
Barry Railway	J. B. Saunders and Co...	Cardiff.
Brecon and Merthyr	J. B. Saunders and Co...	Cardiff.
Bute Docks and Railways	J. B. Saunders and Co...	Cardiff.
Caledonian	A. S. Dunn	25, Killermont-street, Glasgow.
Cambrian	J. B. Saunders and Co...	Cardiff.
Festiniog	J. B. Saunders and Co...	Cardiff.
Furness	William Fleming	Barrow-in-Furness.
Glasgow and South-Western	James Reid	St. Enoch Station, Glasgow.
Great Eastern	F. Hollins	Liverpool-street Station, E.C.
Great North of Scotland	P. M. Barnett, C.E.	Aberdeen.
Great Northern	T. Ireland	Retford.
Great Western	H. T. Goodenough	Paddington Station, W
Hull and Barnsley	E. de M. Malan	Alexandra Dock, Hull.
Lancashire and Yorkshire	Harry R. Jackson	Horwich, near Bolton.
London, Brighton, and South Coast	E. J. Houghton	London Bridge Station, S.E.
London, Chatham, and Dover	Francis Rudall	Victoria Station, S.W.
London and North-Western	J. W. Fletcher, A.M.I.C.E W. T. Tunbridge	London-rd. Station, Manchester. Stafford.
London and South-Western	C. Goldstone	Southampton Station.
Manchester and Milford	J. B. Saunders and Co...	Cardiff.
Manchester, Sheffield, and Lincoln	R. S. Hampson	Godley Junction.
Manchester South Junction and Altrincham	R. S. Hampson	Godley Junction.
Mersey Tunnel	J. Lavender	11, Todd-street, Manchester.
Metropolitan	C. E. Spagnoletti, M.I.C.E	Paddington Station, W.
Metropolitan District	George Estall, A.M.I.C.E.	Lillie Bridge Works, S.W.
Midland	W. E. Langdon	Derby Station.
Midland & South-Western Junction	J. B. Saunders and Co...	Cardiff.
Mid Wales	J. B. Saunders and Co...	Cardiff.
Neath and Brecon	J. B. Saunders and Co...	Cardiff.
Newport (Mon.) Docks and Railway	J. B. Saunders and Co...	Cardiff.
North British	A. F. Clement	Edinburgh.
North-Eastern	A. Graves	York.
North London	H. J. Pryce	Bow.
North Staffordshire	J. Neale	Stoke-on-Trent.
North Wales, Narrow Gauge	J. B. Saunders and Co...	Cardiff.
Pontypridd, Caerphilly, & Newport	J. B. Saunders and Co...	Cardiff.
Rhymney	J. B. Saunders and Co...	Cardiff.
South-Eastern	William Leonard	Tonbridge.
Taff Vale	J. B. Saunders and Co...	Cardiff.
West Lancashire	J. Lavender	11, Todd-street, Manchester.
Wrexham, Mold, and Connah's Quay	J. B. Saunders and Co...	Cardiff.

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POST OFFICE TELEGRAPHS.

General Post Office, St. Martin's-le-Grand, London, E.C.

Postmaster-General	Rt. Hon. ARNOLD MORLEY, M.P.
Secretary	SPENCER WALPOLE.
Financial Secretary	ALGERNON TURNOR, C.B.
Third Secretary	HERBERT JOYCE, C.B.
Assistant-Secretary (for Telegraphs)	J. C. LAMB, C.M.G.
Principal Clerks for Telegraphs	JOHN ARDRON. V. H. BISCOE. ALAN E. CHAMBRE.

TELEGRAPH BRANCH, SECRETARY'S OFFICE.

Special Section.

J. P. Mac Gregor,	J. R. Burr,
G. E. Salmond,	J. Duff,
P. G. Burrell,	W. D. Conquest,
R. J. Mackay,	J. De Wardt,
V. H. Stephens,	H. A. Hall.

General Correspondence Section.

F. R. Langton,	F. J. Brown,
J. Chambers,	N. Hautrive,
W. M. Gattie,	A. L. Forrest,
F. Martelli,	V. Corry,
G. McLaren,	C. E. Mullens.
P. Z. Round,	

Extensions Section.

Colin Brodie,	E. H. Laurie,
C. F. Cartwright,	J. Hodges,
H. W. Cardew,	A. H. Beswick,
H. L. Kingsford,	J. Summers.

Press Section.

C. G. Hall.	C. Stevens,
W. Nops,	F. W. H. Preston,
G. R. Tapp,	G. H. Jackson,
T. G. Stuart,	M. L. Gardiner.

Superintendent for Telegraph Business at Race Meetings, &c.	Mr. T. Mason.
Assistant Superintendent	„ H. T. Toothill.
Superintendent Intelligence Branch	„ W. G. Faunch.

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POST OFFICE TELEGRAPHS.—*Continued.*

ENGINEERING DEPARTMENT.

Engineer-in-Chief and Electrician	Mr. W. H. Preece, C.B., F.R.S.	General Post Office, London, E.C.
Assistant Engineer-in-Chief	„ J. Hookey	
Principal Technical Officer	„ J. Gavey	
1st Class Technical Officers	„ H. C. Hart	
	„ J. B. Chapman	
	„ J. H. Cordeaux	
	„ M. Cooper	
2nd Class Technical Officers	„ A. Graves	
	„ H. R. Kempe	
	„ T. H. Stockwell	
	„ P. Ennis	
	„ A. Eden	
	„ H. Hartnell	
	„ A. J. Stubbs	
Clerks	„ R. C. Leversedge	
	„ T. Reid	

Submarine Superintendent (Woolwich)	Mr. D. Lumsden	
„ „ (Dover)	„ W. R. Culley	
Assist. Submarine Superintendent (Woolwich)	„ H. Marsh	
„ „ „ (Dover)	„ F. Pollard	

Superintending Engineer (for London)	Mr. H. Eaton	Mount Pleasant, London, E.C.
Assist. Superintending Engineer (London)	„ C. T. Fleetwood	

Superintending Engineers	„ J. C. Chambers	Leeds.
	„ F. E. Evans	Birmingham.
	„ J. Gibson	Edinburgh.
	„ W. Louth	Dublin.
	„ E. Ashton	Glasgow.
	„ G. H. Comport	Nottingham.
	„ J. Doherty	Manchester.
	„ A. W. Heaviside	Newcastle-on-Tyne.
	„ J. R. Edwards	Liverpool.
	„ H. Pomeroy	Cork.
	„ J. Jenkin	Cambridge.
	„ J. Walby	Belfast.
	„ H. J. Vose	Cardiff.
	Majr. G. W. Addison, R.E.	London.

Navigating Commander	Mr. F. Alford	Cable Ship "Monarch."
Chief Officer	„ W. C. Hart	
Chief Engineer	„ R. McNab	

Navigating Commander	„ J. Wrake	Cable Ship "The Lady Carmichael."
Cheif Officer	„ G. Lever	

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POST OFFICE TELEGRAPHS.—*Continued.*

CONTROLLER OF STORES OFFICE.

Controller	Mr. C. E. Stuart	Telegraph Street, E.C.
Assistant Controller	„ A. F. Varley	
Superintending Examiners	„ J. Day	
	„ H. J. Cox	
	„ J. H. Ingram	
Assistant do. do.:		
Mr. W. J. Etheredge,	Mr. W. G. Hinton,	
„ G. Morgan,	„ J. Bolton.	
First Class Examiners:		
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„ S. W. Percy,	„ W. H. Allen,	
„ J. Lofthouse,	„ R. L. Dawson.	
Second Class Examiners:		
Mr. J. B. Fulcher,	Mr. A. Dell,	
„ C. Hasdell,	„ C. Ward,	
„ G. H. Ardy,	„ W. Nash,	
„ R. E. Milton,	„ H. J. Langton,	
„ H. A. Cheel,	„ J. H. G. Taylor,	
„ H. Schramm,	„ W. J. Honnor,	
„ H. Sparkes,	„ T. S. Filmer.	
„ E. T. Gillett,		
Superintendents of Factories	„ J. W. Willmot	Bovay Place, Holloway, London, N.
	„ M. F. Roberts	Mount Pleasant, London, E.C.

CENTRAL TELEGRAPH OFFICE.

Controller	Mr. H. C. Fischer
Deputy Controller	„ E. May
Assistant Controllers	„ T. Barlow
	„ H. Smith
Do. do.	„ J. T. Hill
	„ J. W. Eames

Superintendents:	A. E. Eames,	J. F. Ducloy,
R. Boxall,	J. F. Jelf,	H. J. Smith,
J. Russell,	L. Weaver,	W. G. Gould.
W. Tyler,	R. Headland,	G. C. Newbury,
G. Gregory,	H. W. Brookman,	A. Stiles,
A. Askins,	H. Mayfield,	C. Stonley.
W. Whight,	J. M. Maclachan,	

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THE INSTITUTION OF ELECTRICAL ENGINEERS

(Formerly the SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS),

2, VICTORIA MANSIONS, 28, VICTORIA STREET, LONDON, S.W.

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ALEXANDER SIEMENS, M.Inst.C.E.

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Latimer Clark, F.R.S., M.Inst.C.E. (1875).
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F. H. Webb.

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INSTITUTION OF ELECTRICAL ENGINEERS—*Continued.*

LOCAL HONORARY SECRETARIES AND TREASURERS:

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Don JOSÉ APARICIO—Representative of the Direct Spanish Telegraph Company, Plaza de las Salesas, 2, Madrid.	SPAIN.
JOHN AYLMER—Civil Engineer, 4, Rue de Naples, Paris.	FRANCE.
J. BERMAN—Inspector of Java Government Telegraphs, Java.	NETHERLANDS INDIES (DUTCH EAST INDIES).
R. O. BOURNE—General Inspector, Post and Telegraph Department, Brisbane, Queensland.	QUEENSLAND.
Prof. C. A. CARUS-WILSON, M.A.—McGill University, Montreal.	CANADA.
J. M. COLLETTE—Engineer-in-Chief of the Netherlands Telegraphs, The Hague.	THE NETHERLANDS.
FRÉDERIC DELARGE—Director-General of the Belgian Telegraphs, Brussels.	BELGIUM.
P. CHRISTIAN DRESING—Superintending Engineer to the Great Northern Telegraph Company, Copenhagen.	DENMARK.
J. J. FAHIE—Indo-European Government Telegraphs, Shiraz.	PERSIA.
ICHISUKE FUJIOKA, M.E., Dr. Eng.—Imperial University, Engineering Section, Tokio.	JAPAN.
WILLIAM J. HANCOCK—Superintendent of Telegraphs and Telephones, Perth, W. Australia.	WESTERN AUSTRALIA.
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H. KINGSFORD—Engineer to the Mexican and Central and South American Telegraphs, Lima, Peru.	MEXICO AND PERU.
R. HOWARD KRAUSE— Managing Director of the Vienna Telephone Company, Ebendorferstrasse, 10, Vienna.	AUSTRIA-HUNGARY.
CHARLES LEMON, Ph.D.—Superintendent of Telegraphs, Wellington.	NEW ZEALAND.
JOHN OLDHAM—Manager River Plate Telegraph Company, Monte Video.	ARGENTINE AND ORIENTAL DEL URUGUAY REPUBLICS.
W. STANDFORD—Government Telegraph Department, Cape Town.	THE CAPE AND SOUTH AFRICA.
CHARLES TODD, C.M.G.—Director-General, South Australian Telegraphs, Adelaide.	SOUTH AUSTRALIA.
P. B. WALKER—Superintendent of Telegraphs, Sydney.	NEW SOUTH WALES.
G. G. WARD—Vice-President and Gen. Manager, Commercial Cable Company, 1, Broadway, New York.	UNITED STATES OF NORTH AMERICA.

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INSTITUTION OF ELECTRICAL ENGINEERS.—(*Continued*).

ABSTRACT OF THE MEMORANDUM AND ARTICLES OF ASSOCIATION.

The chief objects for which the Institution is established are :—

To promote the general advancement of Electrical and Telegraphic Science and its applications, and to facilitate the exchange of information and ideas on these subjects amongst the Members of the Institution and otherwise, and for this purpose—To hold meetings of the Institution for reading and discussing communications bearing upon Electrical and Telegraphic Science, or the applications thereof, or upon subjects relating thereto. To hold or promote Exhibitions of instruments, apparatus, or other appliances connected with Electrical or Telegraphic Science, or its applications. To print, publish, sell, lend, or distribute the proceedings or reports of the Institution, or any papers, communications, works, or treatises on Electrical or Telegraphic Science, or its applications, or subjects connected therewith, in the English or any foreign tongue, or any abstracts thereof, or extracts therefrom. To take charge of the books, pamphlets, publications, and manuscripts known as the Ronalds Library, which are the subject of a Deed of Trust dated 24th June, 1875, and to observe and perform the Trusts of the said Deed, and to add to the said Ronalds Library, or form any supplemental or additional library of books, works, or manuscripts on Electrical or Telegraphic Science, or the applications thereof, or other subjects allied thereto. To make grants of money, books, apparatus, or otherwise for the purpose of promoting invention and research in Electrical or Telegraphic Science, or its applications, or in subjects connected therewith. To purchase, take on lease, or otherwise acquire, and also let, lease or to dispose of, any premises or other property for the purposes of the Institution, subject to the provisions of Section 21 of the Companies Act, 1862. To do all other such lawful things as are incidental or conducive to the attainment of the above objects.

The Institution shall consist of Members, Associates, Foreign Members, Students, and Honorary Members. Every Member shall come within one of the following descriptions :—(*a*) He shall have been regularly educated as a Telegraph Engineer or Electrical Engineer or Electrician (according to the usual routine of pupilage), and have had subsequent employment for at least five years in responsible situations; (*b*) or he shall have practised on his own account in the profession of a Telegraph Engineer, Electrical Engineer, or Electrician, for at least two years, and have acquired a degree of eminence in the same; (*c*) or he shall be so intimately associated with Electrical or Telegraphic Science that the Council consider his admission to Membership would conduce to the interests of the Institution.

ASSOCIATES shall, except in the case of those transferred from the class of Students, be persons of more than 21 years of age; and all Associates, whether so transferred or not, shall be persons who are connected with Electrical or Telegraphic Science or Engineering, either professionally or otherwise, or who are so intimately associated with Electrical or Telegraphic Science that the Council consider their admission as Associates would conduce to the interests of the Institution.

FOREIGN MEMBERS shall be *foreigners* residing abroad, engaged in, or intimately connected with, Electrical or Telegraphic Science or Engineering, whose admission to the privileges of Membership the Council consider would conduce to the interests of the Institution.

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STUDENTS shall be persons who are serving pupilage to an Electrical Engineer, or who are studying Electrical Science at one of the Universities, Public Colleges, Technical Institutions, or Government Schools, approved by the Council, and who are duly recommended by a Member. After two years from the date of the election of a Student, he shall, if he comes within the description given in Article 10, be eligible for transfer from the class of Students to the class of Associates. If not so eligible for transfer at the end of three years from the date of his election, he shall, if he have then attained the age of 21 years, and otherwise on attaining that age, cease to be a Student of the Institution or to be otherwise connected therewith. Any person who shall cease to be a Student of the Institution by the operation of the above Regulation, shall be eligible at any subsequent time to be elected as an Associate or Member, if nominated and balloted for in the ordinary way.

HONORARY MEMBERS shall be distinguished persons who, from their position or attainments, are intimately connected with Electrical or Telegraphic Science or Engineering, or the practical application thereof, but who are not professionally engaged therein.

Every candidate for election into the Institution, otherwise than as an Honorary Member, shall be duly proposed and seconded, in writing, by a Member; the Secretary shall thereupon submit his application to the Council, to be considered, and, if it is approved by them, it shall be brought before the next General Meeting of the Institution for approval.

HONORARY MEMBERS shall be elected by the Council, and notice of such Election shall be given at the next General Meeting of the Institution, but not more than one Honorary Member shall be elected in any one year.

BALLOTS shall take place at the Ordinary General Meetings of the Institution, but no candidate for admission shall be balloted for at the same meeting at which his application is announced. Members and Associates only have the right of voting for admission of candidates. The proportion of votes necessary for the election of any candidate shall be at least two-thirds of the total number of votes given. In the case of the non-election of a candidate, a second ballot shall be granted, if demanded, by a written notice addressed and sent to the Secretary within a fortnight by any three persons having a right to vote, and such ballot shall take place at the next General Meeting at which candidates are balloted for.

The Council shall decide upon the applications for transferring any Member of the Institution from one class to another.

Every Member elected before the 31st of December, 1891, shall pay to the Institution an entrance fee of Two Guineas on his election; or, if elected after the said date, an entrance fee of Three Pounds. Every Foreign Member shall pay an entrance fee of One Guinea. Every Associate, if elected before the 31st December, 1891, shall pay an entrance fee of One Guinea; or, if elected after the said date, One Pound Ten Shillings. Every Associate transferred to the Class of Members before the 31st of December, 1891, shall pay a further entrance fee of One Guinea; or if transferred after the said date, a further entrance fee of One Pound Ten Shillings. Every Student transferred to the Class of Associates shall pay an entrance fee of One Guinea.

Except as hereinafter provided, every Member elected before the 31st of December, 1891, shall contribute annually to the Institution the sum of Two Guineas; or, if elected after the said date, the sum of Three Pounds. Every Associate elected before the 31st December, 1891, shall contribute annually the sum of One Guinea; or, if elected after the said date, the sum of One Pound Ten Shillings. Every Foreign Member shall contribute annually the sum of One Pound, and every Student Half-a-Guinea. Any Member or Associate residing abroad, or absent from the United Kingdom for nine months in any year, and

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giving previous notice in writing to the Secretary of his intended absence, shall contribute annually the sum of One Pound.

Honorary Members shall not be required to pay any contributions.

Any Member elected before the 31st December, 1891, may compound for his annual subscription by the payment to the Institution in one sum of Twenty-one Pounds if resident in the United Kingdom, or, if resident abroad, by the payment in one sum of Ten Pounds. Any Member elected after the said date may compound by the payment in one sum of Twenty-five Pounds if resident in the United Kingdom, or, if resident abroad, by the payment in one sum of Ten Pounds. Any Associate elected before the 31st December, 1891, may compound for his annual subscription by the payment in one sum of Ten Pounds; or, if elected after the said date, by the payment in one sum of Twelve Pounds Ten Shillings if resident in the United Kingdom, or of Ten Pounds if resident abroad. Any Foreign Member may similarly compound by the payment in one sum of Ten Pounds. Any Foreign Member, or any Member who, as residing abroad, has compounded by payment of Ten Pounds, shall, if he come to reside in the United Kingdom, and if he was elected before the 31st December, 1891, pay either an additional composition of Eleven Pounds or an annual subscription of One Guinea. If he was elected after the said date, he shall pay either an additional composition of Fifteen Pounds or an annual subscription of Two Pounds. Any Associate elected after December 31st, 1891, who, as residing abroad, has compounded by the payment of Ten Pounds, shall, if he comes to reside in the United Kingdom, pay either an additional composition of Two Pounds Ten Shillings or an annual subscription of Ten Shillings. All such compositions shall be invested, and the interest alone shall be appropriated to the current expenditure of the Institution at the direction of the Council. Any donations in aid of the funds of the Institution may be accepted by the Council and Treasurer.

A Foreign Member who has not compounded shall, if he come to reside in the United Kingdom, pay an annual subscription of Two Guineas if he was elected before the 31st December, 1891, or of Three Pounds if he was elected after the said date.

An Associate resident in the United Kingdom who has compounded by payment of Ten Pounds shall, if transferred to the Class of Members before the 31st December, 1891, pay either an additional composition of Eleven Pounds or an annual subscription of One Guinea. If transferred after the said date, he shall pay either an additional composition of Fifteen Pounds or an annual subscription of Two Pounds. An Associate resident in the United Kingdom who has not compounded shall, if transferred to the Class of Members before the 31st December, 1891, pay an annual subscription of Two Guineas; or, if transferred after the said date, an annual subscription of Three Pounds.

The Annual contributions shall be payable in advance on the 1st of January in each year.

In case the expulsion of any individual shall be judged expedient by ten or more Members or Associates, and they think fit to draw up and sign a proposal requiring such expulsion, the same, being delivered to the Secretary, shall be by him laid before the Council for consideration.

THE COUNCIL shall consist of the President, past Presidents, four Vice-Presidents, Twelve Members, three Associates, and the Honorary Treasurer, and all these (except the three Associates) shall be chosen from the class of Members.

The President, Vice-Presidents, Auditors, and Treasurer shall be elected annually by ballot, and, with the exception of the President, shall be immediately eligible for re-election; but the President shall be ineligible for re-election to that office during the following year. Three Members of the Council and the three

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Associate Members shall retire annually, and be ineligible for re-election during the following year. Casual vacancies in the Council during the year may be filled up by the Council, and announced at the next Meeting of the Institution. The Council shall, previous to the Annual General Meeting in each year, prepare a list of Members whom they propose as suitable for the offices of President, Vice-Presidents, and Treasurer for the ensuing year. The list shall also contain the names of a sufficient number of Members and Associates to fill the vacancies in the Council, and whom the Council nominate as fitted to become Members of the Council.

The COUNCIL shall meet as often as the business of the Institution may require; and at every meeting five shall constitute a quorum. The Council may appoint sub-committees, chosen from their own body, for special purposes, and with such powers as the Council may prescribe.

The Sessions of the Society shall commence on or about the 1st November of each year, and terminate on or about the 1st June of the following year. During these months the Meetings of the Institution will be held at such place and on such evenings as the Council may appoint, and notice of which will be given to Members and Associates by the Secretary before the commencement of each Session.

The Annual General Meeting of the Institution shall be held at the Meeting next previous to Christmas Eve, to receive and deliberate upon the Report of the Council on the state of the Institution, and to elect the Officers for the ensuing year. No new question shall be introduced, or motion be made, at an Ordinary General Meeting later than one hour and a half after the time fixed for the commencement of such Meeting.

Every Member and Associate shall have the privilege of introducing one visitor, to be present at the Ordinary General Meetings of the Institution, on writing his name in a book provided for that purpose, or sending with him a card signed with his name, according to a form provided. No question shall be discussed, or motion be made, at the Ordinary General Meetings relative to the direction and management of the concerns of the Institution.

A Special General Meeting of Members and Associates may be called at any time by the Council for a specific purpose relative to the direction and management of the concerns of the Institution, and the Council are at all times bound to do so on a requisition, in writing, of ten Members and Associates, specifying the nature of the business to be transacted.

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OBJECTS OF THE ELECTRICAL AND ALLIED TRADES SECTION.

The special advantages of organising under the auspices of the Chamber of Commerce are, that the Chamber is in possession of suitable premises and staff, under which the necessary work of the Section can be adequately performed; time is spared to members in preparing Bye-Laws and other regulations of procedure; whilst no financial responsibility is involved beyond payment of the entrance fee and subscription to obtain membership of the Chamber; nor is it necessary even for members, in case they are not satisfied with the management of the Committee, to continue their membership or subscription, as enrolment in the Chamber does not involve more than an annual subscription, which can always be terminated by a month's notice prior to the expiration of the current year. The formation of the Section in connection with the Chamber is in every way, therefore, less costly and at the same time more effective than if it were attempted to form a separate Committee apart from the Chamber.

The Electrical and Allied Trades Section does not interfere with the work of existing Associations, but only deals with matters that are purely commercial. The Section, in fact, is an integral part of the London Chamber of Commerce—a body composed of over 3,500 Members engaged in almost every kind of trade and industry. No less than 35 Trade Sections, formed within the Chamber itself, are directly represented on the Council by their own delegates, in addition to 17 of the leading Mercantile Associations in London, and it is intended to give the same right to the remaining branches of commerce. It was felt that so important an interest as that of the electrical and allied branches should not remain without direct representation, and this has been secured by the formation of the Electrical and Allied Trades Section, whose chairman possesses a seat on the Council of the Chamber, to whom he submits for confirmation all resolutions, reports, or recommendations adopted by the Section. Action is then taken in the name of the Chamber itself.

Amongst the matters with which the Section has dealt may be mentioned—The Standardising and Certification of Meters and other Electrical Measuring Instruments by the Government, and the establishment of a Laboratory for this purpose; the Board of Trade Overhead Wire Regulations; the British Association Standard Screw-Thread; Railway Rates; United Action of Electric Supply Companies in the matters of the Legal Expenses of Local Authorities, and of selling their Undertakings at a Shorter Period than 42 years; County Council Bye-Laws for Regulation of London Overhead Wires; Electrical Traction; Crystal Palace and Frankfort Electrical Exhibitions; Foreign Tariffs, Customs Classification, Arbitrations (under the Bye-Laws of the London Chamber of Arbitration). On some of these subjects the recommendations which the Section has made have already been of special value, and have been recognised by Government and other Departments.

Secretary of the London Chamber of Commerce . KENRIC B. MURRAY.

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ROYAL COLLEGE OF SCIENCE.

SOUTH KENSINGTON AND JERMYN STREET, LONDON.

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Chemistry.—Prof. T. E. Thorpe, B.Sc.(Vic.), Ph.D., F.R.S.; Assistant Professor, W. P. Wynne, D.Sc.; Demonstrators, H. Chapman Jones and A. E. Tutton; Assistants, G. S. Newth, J. W. Rodger, and W. Tate; Teaching Scholars, W. Kirman, and H. Grime.
Mechanics and Mathematics.—Prof. T. M. Goodeve, M.A.; Assistant Professor, A. R. Willis, M.A., D.Sc.; Instructors, P. T. Wrigley, M.A., and J. Harrison, M.Inst.M.E., Assoc. M.Inst.C.E.; Demonstrator, J. E. Livsey, M.Inst.M.E.; Assistant, G. A. Baxandall.
Physics.—Prof. A. W. Rücker, M.A., F.R.S.; Assistant Professor, C. V. Boys, F.R.S.; Occasional Lecturer, Captain W. de W. Abney, C.B., D.C.L., F.R.S. (late R.E.); Demonstrator, H. H. Hoffert, D.Sc.; Assistants, W. Watson, B.Sc., W. Williams, and E. Edser.
Metallurgy.—Prof. W. Chandler Roberts-Austen, C.B., F.R.S.; Instructor in Assaying, E. J. Ball, Ph.D.; Assistants, E. A. Smith and H. C. Jenkins, Assoc. M.Inst.C.E.
Registrar.—(Vacant).
Clerk and Librarian.—A. E. Cooper.

ROYAL COLLEGE OF SCIENCE, DUBLIN.

Physics.—Prof. W. F. Barrett, F.R.S.E., M.R.I.A. (Dean of Faculty, Session 1893-94); Assistant, W. Brown.
Applied Mathematics and Mechanism.—Prof. W. McFadden Orr, M.A.; Demonstrator, J. P. Johnston.
Engineering, &c.—Prof. James Lyon, M.A.; Assistant, J. Taylor.
Chemistry and Metallurgy.—Prof. W. N. Hartley, F.R.S., F.C.S., F.R.S.E.
Secretary.—Prof. J. P. O'Reilly, C.E., M.R.I.A.

MASON COLLEGE, BIRMINGHAM.

Principal.—Robert S. Heath, M.A., D.Sc.
Secretary and Registrar.—G. H. Morley.

ELECTRICAL DEPARTMENT.

Mathematics.—Prof. Robert S. Heath, M.A., D.Sc.; Lecturer, L. Crawford, B.A.
Physics.—Prof. J. H. Poynting, D.Sc., F.R.S.; Assist. Lecturer, Philip L. Gray, B.Sc.
Chemistry.—Prof. W. A. Tilden, D.Sc., F.R.S., F.I.C.; Assistant Lecturer, W. W. J. Nicol, M.A., D.Sc., F.I.C.; Demonstrators, Thomas Turner, Assoc. R.S.M., F.I.C., and S. Williamson, Ph.D.
Civil, Mechanical and Electrical Engineering.—Prof. Robert H. Smith, M.I.M.E., Assoc.M.Inst.C.E.; Demonstrator and Workshop Instructor, Harry M. Waynforth.

FIRTH COLLEGE, SHEFFIELD.

Principal.—Prof. W. M. Hicks, Sc.D., F.R.S.
Mathematics.—Prof. A. H. Leahy, M.A.
Physics.—Prof. W. M. Hicks, Sc.D., F.R.S.; Demonstrator, R. Lehfeldt, B.A.
Chemistry.—Prof. W. Carleton Williams, B.Sc., F.C.S.; Demonstrator, Dr. George Young.
Registrar and Secretary.—Ensor Drury.

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SHEFFIELD TECHNICAL SCHOOL.

Principal.—Prof. W. Ripper, M.I.M.E.
Engineering.—Prof. W. Ripper; Demonstrators, F. Boulden, Jos. Husband, A.R.C.S., and J. W. Kershaw, B.Sc.
Metallurgy.—Prof. J. O. Arnold, F.C.S.; Demonstrator, Jos. Jefferson, A.R.S.M.
Physics and Electrical Engineering.—Ellis H. Crapper.
Mathematics.—F. Boulden, Jos. Husband, R. S. Thompson, and J. Stebbings.
Electro-Metallurgy.—Byron Carr.
Secretary.—Walter Swift.

HERIOT-WATT COLLEGE, EDINBURGH.

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Chemistry.—Prof. John Gibson, Ph.D., F.R.S.
Mechanical Engineering.—Prof. Richard Stanfield, F.R.S.E., A.M.I.C.E.
Applied Physics and Electrical Engineering.—Prof. R. Mullineux Walmsley, D.Sc., F.R.S.E., M.I.E.E.
Mathematics.—James M'Kean, F.E.I.S.; James A. Wilson, M.A., B.Sc.
Instructors in Handicrafts.—A. R. Mackay, W. Webster.

THE GLASGOW AND WEST OF SCOTLAND TECHNICAL COLLEGE, GLASGOW.

Natural Philosophy.—Prof. James Blyth, M.A., F.R.S.E.; Assistant, Angus McLean, B.Sc., C.E.
Chemistry.—Prof. Geo. G. Henderson, D.Sc., M.A.; Assistants, Thomas Gray, B.Sc., James Robson, F.I.C., F.C.S., and Augustus Schlœsser, M.Sc., Ph.D.
Electrical Engineering.—Prof. Andrew Jamieson, M.I.C.E., F.R.S.E.; Assistant, J. Livingstone.
Machine Design.—Alexander MacLay, B.Sc., C.E.; Assistants, James Hamilton and David Finlayson.
Technical Chemistry.—E. J. Mills, D.Sc., F.R.S.; Assistant, James Morison.
Mathematics.—Prof. William Raitt, M.A., B.Sc.; Assistant, John Dougall, M.A.
Applied Mechanics.—Prof. William T. Rowden, B.Sc.; Assistant, John Duncan.
Metallurgy.—A. Humboldt Sexton, F.C.S., F.I.C.; Assist., Henry C. Thorpe, B.A.
Steam and Steam Engines.—Wm. H. Watkinson, Wh.Sc., M.I.M.E.; Assistant, Robert M. Anderson.
Civil Engineering.—Gilbert Thomson, M.A., C.E.
Mining and Geology.—Louis H. Cook, A.R.S.M.
Chairman of Governors.—Thomas Russell.
Secretary and Treasurer.—John Young, M.A., B.Sc.

QUEEN'S COLLEGE, BIRMINGHAM.

Warden.—Rev. W. H. Poulton, M.A.
Chemistry.—W. A. Tilden, D.Sc.
Physics.—J. H. Poynting, D.Sc.

ST. DAVID'S COLLEGE, LAMPETER.

Principal.—Very Rev. J. Owen, M.A.
Head Master of the College School.—Rev. Thomas M. Evans, M.A.
Physical Science and Mathematics.—Prof. A. W. Scott, M.A.
Pure Mathematics.—Lecturer, P. J. Kirkby, B.A.

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BRADFORD TECHNICAL COLLEGE.

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Higher Mathematics, Physics and Electrical Engineering (Day School).—J. T. Riley, D.Sc.(Lond.)
Chemistry (Day School).—S. F. Stell.
Chemistry Department.—Head Master, A. Dufton, B.A.; Assistant, Frederick Tetley.
Mechanical and Engineering Department.—Head Master, G. F. Charnock, Assoc. M.Inst.C.E.; Assistant Master, J. E. Rycroft.
Secretary.—John Nutter.

HUDDERSFIELD TECHNICAL COLLEGE.

Chemistry.—George Jarmain, F.I.C.
Engineering.—Thomas Kershaw, M.S.A.
Physics.—Alfred Sheard.
Mathematics.—W. H. Hirst, B.A.
Organising and Managing Secretary.—Austin Keen, F.C.S.

MANCHESTER MUNICIPAL TECHNICAL SCHOOL.

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Mechanical Engineering.—H. G. Jordan, A.R.C.S. (Dublin), F. C. Forth, W. H. Davies, W. H. Cummins, and W. A. Rogerson.
Chemistry.—E. Knecht, Ph.D.; J. Grant, F.C.S.; and E. L. Rhead.

ELECTRICAL STANDARDIZING, TESTING AND TRAINING INSTITUTION,

FARADAY HOUSE, CHARING CROSS ROAD, LONDON, W.C.

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Engineer.—H. H. P. Powles, A.M.I.C.E., M.I.M.E.
Mathematical Lecturer.—Alexander Russell, M.A.
Chemical Lecturer.—Charles J. Wilson, F.I.C., F.C.S.
Demonstrator.—A. Campbell, M.A., Haydn T. Harrison, A.I.E.E.
Secretary.—Philip Arderne Latham, M.A.

RUTHERFORD COLLEGE, NEWCASTLE-ON-TYNE.

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Mathematics and Physics.—R. H. Jude, D.Sc.
Applied Mathematics.—C. Innes, M.A.
Chemistry and Metallurgy.—G. Smith, B.Sc.
Mechanical Engineering.—C. Innes, M.A.
Secretary.—H. Crawford Smith.

BRISTOL MERCHANT VENTURERS' TECHNICAL SCHOOL.

Head Master.—J. Wertheimer, B.Sc., B.A., F.C.S., F.I.C.
Electrical Engineering and Physics.—W. Wilson, M.A., and T. Dobson, B.A.
Mathematics.—F. W. Shurlock, B.A., B.Sc., and G. Smith, B.A.
Engineering.—John Munro, M.I.Mech.E.
Chemistry.—C. E. Boucher, B.Sc.
Telegraphy.—A. Oakshott.
Metal Working.—C. E. Hill.
Plumbing.—W. H. Perry and T. J. Edmunds.

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ROYAL NAVAL COLLEGE, GREENWICH.

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Applied Mechanics.—Prof. J. H. Cotterill, M.A., F.R.S.; Instructor, Robert B. Dixon.
Physics.—Prof. A. W. Reinold, M.A., F.R.S.; Assistant Prof. J. W. W. Waghorn, D.Sc.; Instructor, T. H. Blakesley, M.A., C.E.
Chemistry.—Prof. Vivian B. Lewes.

ROYAL MILITARY ACADEMY, WOOLWICH.

Assist.-Commandant and Secretary.—Col. J. M. Murray, R.A.
Mathematics and Mechanics.—H. Hart, M.A.
Chemistry and Physics.—Dr. W. R. E. Hodgkinson.

ROYAL ENGINEERING COLLEGE, COOPER'S HILL, STAINES.

(Nominations to the Indian Telegraph Department are made from the Engineer Student at this College at the end of their first year of study.)

President.—General Sir Alexander Taylor, G.C.B., R.E.
Applied Mathematics.—G. M. Minchin, M.A.
Pure Mathematics.—A. Lodge, M.A.
Engineering.—Callcott Reilly, M.Inst.C.E.
Demonstrator in Mechanical Laboratory.—P. Reilly.
Chemistry.—Herbert McLeod, F.R.S.; Demonstrator, F. E. Matthews, Ph.D.
Physics.—W. N. Stocker, M.A.; Demonstrator, F. Shields, M.A.
Secretary.—Lieut.-Col. W. J. Boyes.

ELECTRICAL AND GENERAL ENGINEERING COLLEGE,

PENYWERN HOUSE, 2 AND 4, PENYWERN ROAD, EARL'S COURT, LONDON, S.W.

Principal.—G. W. de Tunzelmann, B.Sc., M.I.E.E.
Senior Instructor.—C. Capito, M.I.E.E., M.I.M.E.
Mathematics and Physics.—G. W. de Tunzelmann; Mathematical Demonstrator, R. R. Corkling.
Electrical Engineering.—G. W. de Tunzelmann and C. Capito.
Civil and Mechanical Engineering.—C. Capito.
Engineering Drawing.—C. Capito and W. D. Porterfield.
Chemistry.—T. G. Nicholson, B.Sc.
Geology and Mineralogy.—J. H. Vanstone and E. Wetherell.

(*See* ADVERTISEMENT *facing* Colleges, Schools, &c., *in* CLASSIFIED SECTION.)

CRYSTAL PALACE COMPANY'S SCHOOL OF PRACTICAL ENGINEERING.

Principal.—J. W. Wilson.
Superintendent of Department.—R. G. Hodson.

HARTLEY INSTITUTION, SOUTHAMPTON.

Executive Officer.—T. W. Shore, F.C.S., F.G.S.
Engineering.—J. Eustice.
Electricity, Physics and Chemistry.—J. Brierley and W. S. Crocker, A.R.C.S.
Mathematics.—I. Jeffares, M.A.

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USEFUL INFORMATION RELATING TO ELECTRICAL LIMITED LIABILITY CONCERNS.

We give below particulars relating to Limited Liability concerns, which we trust will be found of service to those of our subscribers having business relations with these Companies. We have endeavoured to make the information complete, and where this is not the case it is because no fuller information is obtainable. We shall be pleased to receive, during 1894, assistance from those who are able to help us in keeping this list complete.

Name of Company, Address of Office, and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called up.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892	Closing Quotation. 1893.
ABELL'S ELECTRICAL ENGINEERING COMPANY, LIMITED.—*In liquidation.*							
ACME AND IMMISCH ELECTRIC WORKS, LIMITED, Queen-street-chambers, Queen-street, E.C.	.....	£20,000 in £1 ord. £5,000 in £1 pref.	.....	...	...	...	...
AFRICAN DIRECT TELEGRAPH COMPANY, LIMITED, Winchester House, E.C. (11 Dec., 1885.)	Sir John Pender, G.C.M.G., M.P. (*Chn.*), Marq. of Tweeddale, Hon. W. St. John F. Brodrick, M.P., J. Denison Pender, Thos. Fuller (*Man.*) *Secretary*, H. E. Plank.	£300,000 in £10 shres £250,000 in 4 % mort. debs.	£236,000 £184,500	Half-yearly Jan. & July	... 4%	... 100-103	.. 101-104
AFRICAN TRANSCONTINENTAL TELEGRAPH COMPANY, LIMITED, 19, St. Swithin's-lane, E.C. (27 Dec., 1892.)	The Duke of Abercorn, K.G. (*Pres.*), Hon. C. J. Rhodes (*Man. Dir.*), Albert Grey, J. Wernher, S. Neumann, R. Maguire, M.P. *Sec. in England*, Herbert Canning.	£140,000 in £1 shares	£35,000	...	...	...	...
AKESTER ELECTRIC SYNDICATE, LIMITED. (5 Oct., 1892.)	Charles T. Praed, Lieut. Arthur R. Dick.	£15,000 in £50 shares	.....	...	...	...	...
AKESTER ELECTRO-MOTOR AND ACCUMULATOR COMPANY, LIMITED, 12, Ropemaker-st, E.C.	.....	£5,000 in £1 shares	£4,348	...	...	...	...
ALBERT ELECTRIC LIGHTING COMPANY, LIMITED, 5, Laurence Pountney-hill, E.C. (2 June, 1891.)	*Secretary*, W. Flack.	£10,000 in £5 shares	£2,000	...	...	...	...
ALUMINIUM COMPANY, LIMITED, 13, Abchurch-lane, E.C.	G. W. Balfour, M.P. (*Chn.*), H. Y. Castner, Lt.-Gen. Sir A. Clarke, R.E., G.C.M.G., J. S. Parkin, Sir H. E. Roscoe, M.P., F.R.S. *Secretary*, G. H. Clarkson.	£60,000 in £1 A shares £20,000 in £1 B shares £100,000 in 6% mor. deb. £9,000 in B debentures	£60,000 £20,000 £99,800 £9,000	...	...	...	...
ALWYN, L., LIMITED, Bristol. (24 Nov., 1892.)	.....	£2,000 in £1 shares	£759	...	...	...	...
AMERICAN RIVER ELECTRIC POWER SUPPLY COMPANY, LIMITED. (28 February, 1893.)	Viscount Grimston, F. Retallack, Comm. O. Young, R.N., J. Taylor, G. C. Pearson.	£25,000 in £1 shares	.....	...	...	...	...
ANDERS' TELEPHONE COMPANY, LIMITED, 31, Queen Victoria-street, E.C. (13 Nov., 1893)	.....	£10,000 in £1 shares	.....	...	...	...	...
ANDREWS AND PREECE, LIMITED, Manchester-road, Bradford. (1 April, 1890.)	T. R. Andrews, Thomas Preece, R. C. Douglas, S. Soargill, A. Hanson, Gustav Schott,	£22,000 in £10 ord. £3,000 in £10 def. £4,000 in debentures	£7,125 £3,000 £4,000	...	5%	...	..

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ANGLO-AMERICAN TELEGRAPH COMPANY, LIMITED, 26, Old Broad-street, E.C. (Established 1866.)	Marquis of Tweeddale (*Chn.*), F. A. Bevan, (*Dep. Chn.*), S. Barber, C. Burt, Sir A. J. L. Cappel, K.C.I.E., W. S. Cunard (*Man.*), J. H. Carson. *Sec.*, T. H. Wells.	£1,134,640 ord. stock £2,932,680 6% pref. stock	£1,134,640 £2,932,680	Quarterly Quarterly	2/15/0 5/10/0	50-51 91-92	43-45 81½-82½
ANGLO-PORTUGUESE TELEPHONE COMPANY, LIMITED, 53, New Broad-street, E.C. (8 June, 1887.)	Sir A. Armstrong, K.C.B., F.R.S. (*Chn.*), Arthur Henry Baker, C. L. W. Fitzgerald. *Man. Dir. in Portugal*, Alan Danvers. *Secretary*, R. Rodgers.	£2,932,680 def. stock £75,000 in £1 shares £10,000 in 6% debs. £40,000 in 8% 2nd mortgage debs.	£2,932,680 £50,000 £10,000 £10,600 (first issue)	Quarterly March Jan. & July Jan. & July	... 5% 6% 8%	10½-10¾	7½-8 ...
ARC ACCUMULATOR COMPANY, LIMITED, 19A, Coleman-street, E.C. (14 May, 1891.)	.....	£1,000 in £1 shares	.....	...	...	...	..
ARCAS PLATING COMPANY, LIMITED—*In liquidation.*							
ASSOCIATION FOR THE PROTECTION OF TELEPHONE SUBSCRIBERS, LIMITED, 58, Coleman-street, E.C. (25 Mar., 1892.)	.....	The liability of each of the 20 members is limited by guarantee to £1				...	...
ATLAS CARBON MANUFACTURING COMPANY, LIMITED, 19, Ewer-street, Southwark, S.E.	.....	£2,000 in £1 shares	.....	...	...	...	...
AURORA ELECTRIC LIGHTING AND DISTRIBUTION COMPANY, LIMITED, 54, New Broad-street, E.C. (29 May, 1891.)	E. F. Le Souef (*Chn.*), C. J. Fox (*Man.*) *Secretary*, F. J. Latorre.	£25,000 in £1 shares	£5,935	...	...	1	8
AUTOMATIC ELECTRIC RAILWAY SIGNAL COMPANY, LIMITED, 11, Rumford-place, Liverpool. (26 Nov., 1892.)	R. B. Annesley, S. Banner, R. W. Brown, J. Bushby, John Charnley, G. R. Leyland, W. H. Potter. *Secretary*, J. Harvey Evans.	£10,000 in £1 shares	£4,102	...	...	...	...
BABCOCK AND WILCOX, LIMITED, 147, Queen Victoria-street, E.C. (26 June, 1891.)	Andrew Stewart (*Chn.*), Sir Wm. Arrol, A. T. Simpson, J. G. Mair Rumley, C. A. Knight (*Man. Europe*), J. H. Rosenthal (*Man. London*). *Secretary*, Walter Shaw.	£140,000 in £10 ord. £100,000 in £10 pref.	£140,000 £100,000	Feb. & Sept. Feb. & Sept.	10% 6%	10½ 10½	10½ 11
BAILY, GRUNDY AND BARRETT, LIMITED, 2, St. Mary's-passage, Cambridge. (18 Jan., 1893.)	.....	£10,000 in £5 shares	£3,010	...	...	...	...
BAILY AND GRUNDY, LONDON, LIMITED, Amberley Works, Paddington, W. (24 April, '93)	.....	£10,000 in £10 shares	.....	...	...	...	...
BEDFORD ELECTRIC LIGHT COMPANY, LIMITED, 3, St. Paul's-square, Bedford. (29 August, 1888.)	.....	£14,750 in £1 ord. £250 in £1 founders'	£198 2s. £154	...	...	...	...
BERNSTEIN ELECTRIC LAMP COMPANY, LIMITED, 40, Chancery-lane, W.C. (29 July, 1885.)	*No particulars obtainable.*	£100,000 in £10 shares	£38,140	...	...	...	...
BESSBROOK AND NEWRY TRAMWAY COMPANY, Bessbrook, county Armagh. (26 May, 1884.)	H. Barcroft, J. F. Harris, C. H. Richardson, J. N. Richardson, junr. *Sec.*, H. Harrison.	£20,000 in £10 shares £6,500 in loans	£15,000	...	...	...	...
BICESTER ELECTRICITY SUPPLY COMPANY, LTD., Market-hill, Bicester. (2 Nov., 1891.)	.....	£5,000 in £5 shares	£65 10s.	...	...	...	...
BIRMINGHAM CENTRAL TRAMWAYS COMPANY, LIMITED, 119, Colmore-row, Birmingham. (24 Jan., 1883.)	Joseph Ebbsmith (*Chn.*), M. J. Smith, W. Neale. *Secretary*, W. Holmden.	£400,000 in £10 ord. £100,000, £10 5% guar. £135,400 4% debs.	£388,000 £100,000 £135,400	September July & Jan.	2½% 5% 4%	3 7¼	... ...

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USEFUL INFORMATION RELATING TO ELECTRICAL LIMITED LIABILITY CONCERNS.—*Continued.*

Name of Company, Address of Office, and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called up.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892.	Closing Quotation. 1893.
BIRMINGHAM ELECTRIC SUPPLY COMPANY, LIMITED, 14, Dale-end, Birmingham. (2 Dec., 1889.)	H. Buckley (*Chairman.*), J. C. Vaudrey (*Managing Director*), G. S. Albright, J. F. Albright, G. H. Johnstone, F. W. V. Mitchell. *Secretary*, C. E. Davis.	£100,000 in £5 shares	£70,000	...	...	...	...
BIRMINGHAM HOUSE-TO-HOUSE ELECTRICITY COMPANY, LIMITED, 39, Bennett's-hill, Birmingham. (26 June, 1889.)	*Secretary*, A. H. Gibson.	£99,500 in £5 ord. £500 in £5 founders'	£500	...	...	..	...
BIRMINGHAM TELEGRAPH FACTORY, LIMITED—	*In liquidation.*						
BLACKMAN VENTILATING COMPANY, LIMITED, 63, Fore-street, E.C. (10 Sept., 1883; 10 July, 1890).	Col. J. T. Griffin (*Chairman.*), M. Shillito (*Man.*), Maj.-Gen. Sir W. H. R. Green, K.C.S.I., C.B., H. Wright, J. D. Sutcliffe. *Secretary*, F. Mudford.	£75,000 in £1 shares	£32,662	October	10%	...	...
BLOCKLEY ELECTRIC LIGHTING AND MANUFACTURING COMPANY, LIMITED, Blockley, Worcestershire. (16 Dec., 1887).	H. N. Warburton, J. D. Hyde, Charles Barter.	£20,000 in £5 shares	£2,640	. .	...	...	...
BOLTON (REGINALD) AND COMPANY, LIMITED, 110, Leadenhall-st, E.C. (22 April, 1893.)	Reginald Bolton (*Man.*), G. Millington, A. T. Salisbury-Jones, F. N. Salisbury-Jones, J. J. Dale, H. Coward, A. S. Berger. *Secretary*,	£12,000 in £5 shares	.....	...	...	...	...
BOURNEMOUTH AND DISTRICT ELECTRIC SUPPLY COMPANY, LIMITED, Observer Chambers, Albert-road, Bournemouth. (1 June, 1891.)	Aymor H. Sanderson (*Chn.*), John Fair, Wm. Fisher, J. A. Hosker, G. J. Piercy, Leveson Scarth. *Secretary*, Charles Offer.	£50,000 in £5 shares £10,000 in 6% 1st mort. debs.	£28,625 £10,000	... Jan., July	5% 6%	...	..
BOURNE AND GRANT ELECTRICITY SUPPLY COMPANY, LIMITED, 15, George-street, Mansion House, E.C. (13 May, 1893.)	.....	£24,900 in £1 ord. £100 in £1 founders'	.....	...	...	...	..
BOY MESSENGERS AND ELECTRIC CALL COMPANY, LIMITED—*business taken over by the* DISTRICT MESSENGER SERVICE AND NEWS COMPANY, LIMITED.							
BRAZILIAN SUBMARINE TELEGRAPH COMPANY, LIMITED, Winchester House, E.C. (8 Jan., 1873.)	Sir John Pender, G.C.M.G., M.P. (*Chn.*), T. Fuller (*Man.*), Hon. W. St. John Brodrick, M.P., Lord Sackville A. Cecil, Sir H. D. Gooch, Bt., J. Denison Pender, F. Youle, Duke de Loulé (*in Portugal*). *Secretary*, R. Collett.	£1,300,000 in £10 shrs. £150,000 in 5% debs. £75,000 in 5% debs. (2nd series)	£1,300,000 £18,700 £75,000	Quarterly Jan. & July June & Dec.	6%*('92-'93) 5% 5% *and 1/- bonus	10½-11¼ 101-4 106-110	11¾-12¾ 101-4 109-113
BRIGHTON AND HOVE ELECTRIC LIGHT CO., LIMITED, 46, Gloucester-rd., Brighton. (16 Dec., 1885.) *Works taken over by Brighton Corporation, Jan., 1894.*)	Robt. Hammond (*Chn.*), Arthur Kimber, P. A. Latham, E. Meyerstein. *Man. and Sec.*, G. W. Spencer Hawes.	£100,000 in £5 shares £15,000 in debs.	£15,005	...	4%	...	...
BRIGHTON AND ROTTINGDEAN SEA-SHORE ELECTRIC TRAMROAD COMPANY.	.....	£12,000 in £10 shares	. ....	...	...	...	...
BRITISH ELECTRIC LIGHT COMPANY, LIMITED, 11, Delahay-street, Westminster, London, S.W. (4 Oct., 1878.)	Martin W. B. Ffolkes (*Chn.*), Hy. Huth Walters. *Secretary*, Charles S. Bingley.	£100,000	£86,400	...	...	...	...

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BRITISH ELECTRIC TRAMWAYS AND GENERAL SYNDICATE, LIMITED, 81, Gracechurch-street, E.C. (15 Dec., 1888.)	*Man. Dir.*, James W. Haynes.	£9,250 in £5 pref. £250 in £5 founders'	.....	...	...	...	...
BRITISH ELECTRO-CHEMICAL AGENCY, LIMITED, 16, Great George-street, Westminster, S.W. (11 Aug., 1891.)	Joseph Ebbsmith (*Chn.*), John B. Verity, James Balfour. *Secretary*, W. J. Caulfield.	£2,500 in £10 vendors' £5,000 in £10 ord.	.....	... ...	...	...	..
BRITISH INSULATED WIRE COMPANY, Prescot, Lancs. (20 Oct., 1890.)	W. Marriner Brigg (*Chn.*), Alfred Adam, J. B. Atherton, S. Z. de Ferranti, J. C. Horsfall, E. K. Muspratt, J. E. Pearson.	£47,250 in £5 A ord. £41,500 in £5 B ord. £19,750 in £5 pref. £1,500 in £5 founders'	£34,390 £35,265 £18,725 £1,500	...	...	..	...
BRITISH TANNING COMPANY, LIMITED—*in liquidation.*							
BRITISH VOLTA ELECTRIC GLOW-LAMP COMPANY, LIMITED, 49, Queen Victoria-street, E.C. (31 Aug., 1893.)	Albert T. Turney, G. White, E. C. Lacey, George Hillard, W. Halgood. *Secretary*, E. C. Morgan Heath.	£2,000 in £1 shares	.....	...	...	...	...
BRUSH ELECTRICAL ENGINEERING COMPANY, LIMITED, 49, Queen Victoria-street, E.C. (10 Aug., 1889.)	J. B. Braithwaite, jun. (*Chn.*), A. H. Sanderson, Col. F. G. Steuart, B. H. Van Tromp, E. Woods, A. Ayres. *Joint Mans.*, J. S. Raworth and R. P. Sellon. *Sec.*, B. Broadhurst.	£450,000 in £3 ord. £300,000 in £2 6% pref. £125,000 in 4½% pref. deb. stock.	£270,000 £180,000	Mar. & Sept. Mar. & Sept. Mar. & Sept.	2/1 6% 4½%	3-3¼ 2⅛-2⅜ ...	2⅝-2⅞ 2⅛-2⅜ 105-107
BUENOS AYRES ELECTRIC LIGHT COMPANY, LIMITED, 1, East India-avenue, E.C. (12 Nov., 1881.)	.....	£99,860 in £10 ord. £140 in £2 founders'	.....	...	...	..	...
BULLERS LIMITED, Birmingham. (6 Oct., 1890.)	E. W. Buller, H. C. Jobson.	£100,000 in £10 shares	.....	...	...	...	...
CALEDONIAN ELECTRIC SUPPLY COMPANY, LTD., Edinburgh. (Aug., 1893.)	.....	£100 in £1 shares	.....	...	...	...	...
CALLENDER'S BITUMEN, TELEGRAPH AND WATERPROOF COMPANY, LIMITED, 101, Leadenhall-street, E.C. (19 April, 1882.)	Sir George R. Prescott, Bt. (*Chairman*), Henry Drake, D. P. McEwen, W. O. Callender, Col. G. A. Elliott, J.P., T. O. Callender (*Managers*). *Secretary*, S. C. Lambert.	£80,000 in £10 shares	£63,160	May.	...		...
CAMBRIDGE ELECTRIC SUPPLY COMPANY, LIMITED, 2, Sidney-street, Cambridge. (18 May, 1892.)	Sir B. C. Browne, D.C.L., G. B. Finch, D. Munsey, Hon. C. A. Parsons J. B. Simpson, G. Whitmore. *Gen. Man. and Sec.*, John H. Barker.	£50,000 in £10 shares	£18,448	...	...	...	...
CAMBRIDGE UNIVERSITY AND TOWN ELECTRIC LIGHTING COMPANY, LIMITED, 2, St. Mary's-passage, Cambridge. (28 June, 1889.)	.....	£50,000 in £10 shares	.....	...	...	...	...
CANTERBURY ELECTRICITY SUPPLY COMPANY, LIMITED, 49, Queen Victoria-street, E.C. (18 October, 1893.)	.....	£50,000 in £1 shares	.....	...	...	...	...
CARBON BATTERY COMPANY, LIMITED, 35, Queen Victoria-street, E.C. (28 Sept., 1892.)	— —	£10,000 in £1 shares	.....	...	...	...	...

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Name of Company, Address of Office, and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called up.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892.	Closing Quotation. 1893.
CARBON ELECTRIC, LIMITED, 33, Old Broad-street, E.C. (15 April, 1891.)	*Secretary*, A. T. Salisbury-Jones.	£10,500 in £5 pref. £9,500 in £5 def.	.....	...	...	...	...
CENTRAL LONDON RAILWAY COMPANY, 30, St. Swithin's-lane, E.C. (1891.)	E. G. De Crano, F. A. Lucas, H. Mosenthal, D. Parrish. *Secretary*, T. Matesdorf.	£2,850,000 in £10 shares £950,000 in loans	.. ...	...	...	...	...
CENTRAL RAIL TRACTION COMPANY, LIMITED, Gt. George-street, S.W. (13 July, 1892.)	.....	£10,000 in £10 shares	.....	...	...	...	...
CHAGFORD AND DEVON ELECTRIC LIGHT COMPANY, LIMITED, Chagford, Devon. (18 Nov., 1890.)	*Man. and Sec.*, G. H. Reed.	£2,000 in £1 shares	£724	...	..	...	...
CHAMBERLAIN AND HOOKHAM, LIMITED, 4, New Bartholomew-street, Birmingham. (14 April, 1883.)	.....	£50,000 in A £10 shares £50,000 in B £10 shares	£3,500 £50,000	March March	7½% 4/-	...	...
CHARING CROSS AND STRAND ELECTRICITY SUPPLY CORPORATION, LIMITED, 12, Maiden-lane, London, W.C. (June, 1889.)	G. H. B. Glasier (*Chn.*), I. P. Mendoza, G. Agostino Gatti and Stefano Gatti (*Man.*) *Sec. and Man.*, E. Wilmot Seale, F.I.S.	£150,000 in £5 ord. £70,000 in 5 % debs.	£150,000 £58,900	June & Dec.	5	5-5¼	...
CHATHAM, ROCHESTER AND DISTRICT ELECTRIC LIGHTING COMPANY, LIMITED, 22, High-street, Chatham.	H. Jasper (*Chn.*), J. W. King, W. J. Mackay, M. H. Hurrell (*Man.*) *Secretary*, George Pepper.	£50,000 in £5 shares £12,000 in 5% 1st mort. debs.	£10,027	...	...	...	...
CHELMSFORD ELECTRIC LIGHTING COMPANY, LIMITED, Arc Works, Chelmsford. (30 March, 1892.)	R. E. B. Crompton, J. F. Albright. *Man.*, A. H. Pott. *Sec.*, F. R. Reeves.	£2,500 in £1 ord. £7,500 in £1 pref.	..... £5,507	...	...	...	...
CHELSEA ELECTRICITY SUPPLY COMPANY, LIMITED, Draycott-place, Sloane-square, London, S.W. (18 Nov., 1884.)	J. Irving Courtenay (*Chn.*), Maj.-Gen. C. E. Webber, C.B. (*Dpty. Chn.*), Nugent Daniell, Emile Garcke, Sir G. R. Prescott, Bt. *Secretary*, S. J. Cluer.	£70,000 in £5 ord. £30,000 in £5 pref. £500 in £1 founders' £30,000 in 6% 1st debs. £20,000 in 6% 2nd debs. £10,000 other borrowing powers.	£51,385 not issued. £500 £30,000 £6,900	... ... Mar., Sept. June, Dec.	2½% 6%	... ...	... ...
CHEMICAL AND ELECTROLYTIC SYNDICATE, LTD. (Sept., 1893.)	N. H. Fenner, W. E. B. Blenkinsop, W. Mac Nab, H. R. Baynes.	£30,000 in £5 shares	.....	...	...	...	...
CHILI TELEPHONE COMPANY, LIMITED, 42, Old Broad-street, E.C. (28 June, 1889.)	Colonel R. Raynsford Jackson (*Chn.*), T. Greenwood (*Vice Chn.*), Hon. F. E. Allsopp, F. W. Jones. In Chili, Fred. W. Kerr (*Gen. Man.*) *Secretary*, Edmund Petley.	£250,000 in £5 shares £100,000 in 6% debs.	£220,000 £50,000	...	5%	3-4	2-3
CHINA AND JAPAN TELEPHONE COMPANY, LTD, 14, Austin Friars, E.C. (31 Jan., 1883.)	Henry Grëwing, T. Lloyd. *Secretary*, A. B. Chalmers.	£20,000 in £1 shares £10,000 in 7% debs.	£14,761 £5,000	...	..	...	...
CHLORIDE ELECTRICAL STORAGE SYNDICATE, LIMITED, 8, King-street, Manchester. (12 Dec., 1891.)	W. Mather, M.P., Edward Hopkinson, and Hardman A. Earle (*Mans.*), G. Annesley Grindle, Hon. James J. Fellows, Edward Tuck, and W. W. Gibbs.	£250,000 in £1 pref. £12,500 in £1 founders'	£9,918 10s. £48	...	...	...	...

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CITY OF BATH ELECTRIC LIGHTING AND ENGINEERING COMPANY, LIMITED, 7, Dorchester-street, Bath. (6 May, 1891.)	T. O. Callender (*Chn.*), Alfred Pitman, E. Pitman, C. J. Wharton, J. Bigland Wood. *Eng. and Man.*, G. F. Matager. *Secretary*, W. Jeffery.	£55,000 in £10 ord. £5,000 in £100 founders' £3,000 in 4½ debs.	£33,340 £5,000 £800	...	... 4% ('91)	...	...
CITY OF LONDON ELECTRIC LIGHTING COMPANY, LIMITED, 1 and 2, Great Winchester-street, London, E.C. (11 July, 1891.)	Sir David Salomons, Bt. (*Chn.*), Edw. Lucas, F. W. Reynolds, Earl of Suffolk and Berkshire, Hon. Alan Charteris, J. B. Braithwaite, jun., Col. B. H. Martindale, C.B. *Man.*, David Cook. *Secretary*, J. Cecil Bull.	£400,000 in £10 ord. £400,000 in 6% pref. £400,000 in debs.	£400,000 £400,000 Not issued.	... ...	... 6% (int.) July, '93.	10½-16¾ 5-5½	11½-11¾ 12¾-13¼
CITY AND SOUTH LONDON RAILWAY COMPANY, LIMITED, 46, King William-street, E.C. (28 July, 1884.)	C. G. Mott (*Chn.*), C. S. Grenfell, S. Hanbury, S. B. Heward, Edwin Tate. *Gen. Man.*, T. C. Jenkin. *Secretary*, W. F. Knight.	£650,000 in £10 ord. £150,000 in £10 5% prf. £225,000 in loans	£630,000 £70,000 £192,430	... Feb. & Aug. May & Nov.	⅜% & ⅝% 5% 5%	...	28-33
CLARKE, CHAPMAN AND COMPANY, LIMITED, Victoria Works, Gateshead-on-Tyne. (June, 1893.)	Capt. A. H. Chapman (*Chn.*), J. B. Furneaux (*Man. Dir.*), H. R. Chapman. *Sec.*, R. Scope.	£150,000 in £10 shares	£140,000	June & Dec.	...	...	...
CLEGG'S METAL INCANDESCENT LAMP COMPANY OF FRANCE, LIMITED, 34, Victoria-street, S.W. (20 May, 1891.)	Col. A. Maclean, L. D. Ryder, C. Cheswright, A. Campbell, C. Cheswright, jun., J. Clegg, J. S. Spencer.	£10,000 in £10 shares	.. ..	...	...	...	...
COLLIER-MARR TELEPHONE AND ELECTRICAL MANUFACTURING COMPANY, LIMITED, Derby-street, Oxford-road, Manchester. (10 Aug., 1892.)	J. W. Maclure, M.P., H. S. Foster, M.P., C. S. Thompson, H. F. Herford, A. T. Collier, A. Marr. *Secretary*, J. W. Provis, jun.	£100,000 in £10 shares	£7,662 10s.	...	...	....	...
COLUMN PRINTING TELEGRAPH SYNDICATE, LIMITED, 5, New Bridge-street, E.C. (3 Aug., 1889.)	Earl of Wharncliffe (*Chn.*) *Secretary*, W. P. Forbes.	£25,000 in £50 shares	£11,450	...	...	...	...
COMMERCIAL CABLE COMPANY, Postal Telegraph Building, Broadway, New York. (Org. 12 Dec., 1883); 55 and 56, Bishopsgate-street, London, E.C.	*Pres.*, J. W. Mackay. *Vice-Pres. and Gen. Man.*, G. G. Ward. *Lond. Dir.*, T. Skinner, 1, Royal Exchange-buildings, E.C. *Gen. Sup. Great Britain*, G. H. Bambridge.	$10,000,000 in $100 shr.	$10,000,000	Jan., Apr., July, Oct.	...	175-180	140-150
COMPAGNIE FRANÇAISE DU TÉLÉGRAPHE DE PARIS À NEW YORK, 53 bis, Rue de Chateaudun, Paris, and 24, Royal Exchange, E.C. (Established 1879.)	MM. Lefaivre (*Pres.*), Sutterlin, de Carrère, Pestel, Halphen, de la Beaumelle, Boullaise, Chauvassaignes, Cibiel, Etard, Lafargue, Marq. de Lauris, Noel Pardon. *Repres. in England*, W. W. Howell.	42,000,000fr. in 500fr. shares.	42,000,000fr.	...	...	...	...
CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, LIMITED AND REDUCED, 109, Farringdon-road, E.C. (9 April, 1881.)	C. L. W. Fitzgerald (*Chn.*), Sir A. Armstrong, K.C.B., F.R.S., A. H. Baker, Henry Grëwing, J. H. Buckingham. *Secretary*, C. Curtoys.	£112,425 in 10s. ord. £75,150 in £1 ord. £47,363 in £1 6% pref.	£112,425 Unissued £47,363	May & Nov. ...	... 6%	3/4-1 5/8	1 1/8-1 3/8
CORLETT ELECTRICAL ENGINEERING COMPANY, LIMITED, Rowbottom-square, Wigan. (7 April, 1892.)	W. Johnson (*Chn.*), J. Brown, T. R. Ellis, T. D. Grimke-Drayton, G. S. Corlett. *Secretary*, J. C. Kenyon.	£10,000 in £10 shares	£6,200	...	...	...	...
COVENTRY ELECTRIC TRAMWAYS, LIMITED, 35, Parliament-street, S.W. (10 May, 1893.)	.....	£25,000 in £5 shares	.....	...	...	...	...

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USEFUL INFORMATION RELATING TO ELECTRICAL LIMITED LIABILITY CONCERNS.—*Continued.*

Name of Company, Address of Office, and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called up.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892.	Closing Quotation. 1893
COUNTY OF LONDON AND BRUSH ELECTRIC LIGHTING COMPANY, LIMITED, 1 and 2, Great Winchester-street, London, E.C. (30 June, 1891.)	Emile Garcke, B. H. Van Tromp. *Secretary*, J. Cecil Bull.	£400,000 in £10 ord. £400,000 in £10 pref.	£400	...	...	...	...
CROMPTON AND CO., LIMITED, Mansion House-buildings, London, E.C. (30 July, 1888.)	Visct. Emlyn (*Chn.*), H. H. J. W. Drummond, C. F. Tufnell, B. Gibson; R. E. B. Crompton and J. F. Albright (*joint Man. Dirs.*) *Secretary*, F. R. Reeves.	£150,000 in £5 ord. £150,000 in £5 pref. £50,000 in £50 5% debs.	£41,928 £140,900 £48,800	Jan. & July Jan. & July. April & Oct.	2½% 6% ...	... 5-5½ ...	.. 4-4½ ...
CROMPTON ELECTRIC SUPPLY COMPANY OF AUSTRALIA, LIMITED, Mansion House-buildings, E.C. (18 June, 1889.)	J. F. Albright, R. E. B. Crompton C. F. Tufnell, W. G. Whiffen. *Secretary*, F. R. Reeves.	£47,500 in £5 A shares (First issue £22,500) £2,500 in £5 B shares £15,000 in 7% 1st mort. bonds.	£15,575 £2,500 £8,800	...	...	...	...
CROMPTON-HOWELL ELECTRICAL STORAGE COMPANY, LIMITED, 4, Mansion House-buildings, E.C. (3 May, 1889.)	J. F. Albright (*Chn.*), R. E. B. Crompton, J. C. Howell, W. A. Albright, G. S. Albright.	£19,000 in £1 ord.	16s. per share paid.	...	...	...	...
CROSSLEY TELEPHONE COMPANY, LIMITED, Albany-buildings, Market-street, Bradford. (11 July, 1884.)	John Waugh, C.E. (*Chn.*), Col. Harrison, Col. Lassen, G. A. Steinthal.	£25,000 in A £5 shares £62,500 in B £5 shares £12,500 in C £5 shares	£3,035 £600 £1,750	...	...	..	...
CROYDON TRAMWAYS COMPANY, Thornton-Heath, Croydon. (1889.)	W. J. Carruthers-Wain (*Chn.*), W. P. Paige, E. R. Polden, W. Stansfield, S. L. Tompkins. *Secretary*, J. G. B. Elliot.	£27,000 ord. £20,000 pref. £21,000 in 6% deb.	£27,000 £15,016 £19,985	... ... Feb. & Aug.	... ... 5%	... ...	... ...
CRYSTAL PALACE DISTRICT ELECTRIC SUPPLY COMPANY, LIMITED, Springfield Works, Upper Sydenham. (30 June, 1883.)	Robert M. Meyer (*Chn.*), Emile Garcke, George Offor (*Man. Dir.*)	£100,000 in £1 shares £35,000 in 6% deb.	£28,586 £35,000	... ...	.. ...	... ...	... ..
CUBA SUBMARINE TELEGRAPH COMPANY, LIMITED, 58, Old Broad-street, E.C. (1870.)	T. Greenwood (*Chn.*), G. Keith, A. F. Low, C. W. Parish. *Secretary*, J. Scott.	£160,000 in £10 ord. £60,000 in 10% pref.	£160,000 £60,000	Feb. & Aug. Feb. & Aug.	8% ...	11½-12½ 17½-18½	11½-12½ 18-19
CUTTING (R. C.), DOUGLASS AND CO., LIMITED, Wardrobe-chambers, Doctors' Commons, E.C. (22 Nov., 1892.	*Manager*, Archibald Douglass. *Sec.*, W. G. Bundy.	£12,000 in £5 shares	... ...	...	...	...	...
CUTTRISS, WALLIS AND CO., LIMITED, Camp-road, Leeds. (22 April, 1891.)	T. Cuttriss, S. W. Cuttriss, E. C. Wallis, J. W. Bannister.	£10,000 in £5 shares	£3,855	...	...	...	...
DALZIEL'S ATLANTIC TELEGRAM COMPANY, LIMITED. (28 Dec., 1892.)	Davison Dalziel, W. C. Hallett, H. V. Huggins, H. F. Jackson, Major John E. Jameson.	£25,000 in £100 shares	£3,850	...	...	...	...
DAN RYLANDS, LIMITED, Hope Glass Works, Stairfoot, Barnsley.	Dan Rylands (*Chn. and Man. Dir.*), C. H. Cobbold, W. T. Howroyd. *Secretary*, W. Brooke,	£100,000 in £5 ord. £175,000 in £5 7% pref. £70,000 in 5½% 1st mort. debs.	£83,085 £129,825 £65,000	October Half-Yearly Jan. & July	10% 7%	.. ...	...

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DAVIS AND TIMMINS, LIMITED, 24, Charles-street, Hatton-garden, E.C. (25 July, 1884.)	.....	£20,000 in £10 shares	£12,530	...	...	...	...
DAWSON, ROGER, LIMITED, 53, Berners-street, W. (3 Jan., 1893.)	A. Roger Dawson and A. Rathbone Cobbett.	£15,000 in £1 shares	£15,000	...	...	...	...
DICK, KERR AND CO., LIMITED, 101, Leaden-hall-street, E.C. (31 May, 1890.)	F. Manuelle (*Chn.*), Maj.-Gen. C. E. Webber, C.B., C. T. Cayley, John Kerr (*Man.*), and G. Flett (*Asst. Man.*). *Secretary*, G. W. Carr.	£80,000 in £5 ord. £30,000 in (£5) 7% pref.	£30,000 £30,000	1st April. 1 Apr., 1 Oct.	... 7%	...	...
DIRECT SPANISH TELEGRAPH COMPANY, 280 Winchester House, E.C. (8 Nov., 1872.)	Sir John Pender, G.C.M.G., M.P. (*Chn.*), E. Etlinger, J. Denison Pender. *Manager*, C. Gerhardi.	£65,000 in £5 ord. £30,000 in 10% pref. £80,000 in 6% debs.	£51,724 £30,000 £62,000	Apr. & Oct. Apr. & Oct. Nov. & May	4% 10% 6%	2½-3½ 9-10	2½-3½ 8½-9½
DIRECT UNITED STATES CABLE COMPANY, LTD., Winchester House, E.C. (17 July, 1877.)	Sir John Pender, G.C.M.G., M.P. (*Chn.*), C. E. Günther, Adml. Hon. Sir H. Keppel, G.C.B., C. Meara, James Pender, E. M. Underdown, Q.C. *Secretary*, T. Finnis.	£1,300,000 in £20 shs.	£1,214,200	Quarterly	3½%	11½-11⅝	11⅝-11¾
DISTRICT MESSENGER COMPANY OF PARIS, LIMITED, 23, Leadenhall-street, E.C. (22 July, 1893.)	C. Brown, G. Bush, A. Coventry, C. Praed, H. Sartoris, J. D. Crawford, G. E. J. Manners, C. T. Russell (*Man.*). *Secretary*, A. Lord.	£80,000 in £1 ord. £112,000 in £1 7% pref. £8,000 in £20 founders'	.....	...	...	...	...
DISTRICT MESSENGER SERVICE AND NEWS COMPANY, LIMITED, 50 & 51, Lime-street, London, E.C. (30 June, 1890.)	A. Bright, G. Bush, Col. A. Collins, Capt. W. H. Davis, Lord F. Hamilton, G. M. Inglis, Hon. P. B. Lyon, J. H. McFadden, G. E. J. Manners, A. Campbell-Praed, C. T. Russell, E. W. Yates. *Sec.*, A. Lord.	£199,000 in £5 ord. £75,000 in £5 6% pref. £1,000 in £5 founders' £20,000 in £50 8% debs.	£89,135 £15,000 £1,000 £19,250	December December Jan. & July	...	...	...
DOMESTIC TELEPHONE COMPANY, LIMITED. 24, Fulham-road, London, S.W. (4 April, 1893.)	Sir Charles S. Forbes, Bart., Hon. J. Manfield, Hon. Claude Hay, Louis T. Fitzgibbon, and T. D. Croft. *Sec.* J. R. Gibson.	£19,950 in £5 A shares £50 in £5 B shares	£7,980	...	...	...	...
DOMINION ELECTRICAL COMPANY, LIMITED. (29 Oct., 1892.)		£25,000 in £5 ord. £125 in 5s. founders'	£1,250 £125	...	...	...	...
DOMINION TELEGRAPH COMPANY, Toronto, Canada.	...	$1,000,000 in fully-paid shares of $50, and £6,000 in 6% ster. bonds of £100	.....	March	...	..	53¾
DOVER ELECTRICITY SUPPLY COMPANY, LIMITED, 49, Queen Victoria-street, E.C. (18 October, 1893.)	Sir William Crundall (*Chn.*), C. W. Bagshawe, B. H. Van Tromp, R. Percy Sellon. *Engineer and Manager*, A. J. Lawson. *Secretary*, B. Broadhurst.	£50,000 in £5 shares	.....	...	...	...	..
DUTTON AND CO., LIMITED, Worcester. (29 June, 1889.)	*Man. Dirs.*, S. T. Dutton R. H. C. Nevile, and S. Corkran. *Sec.*, G. W. Bull.	£60,000 in £10 shares	.....	...	...	...	...
EASTBOURNE ELECTRIC LIGHT COMPANY, LIMITED, Grove-road-chambers, Eastbourne. (15 Feb., 1882.)	George Boulton (*Chn.*), J. G. Langham, J. A. Skinner, H. Sutton. *Manager*, H. W. Wilkinson. *Secretary*, H. Towner.	£50,000 in £10 shares £25,000 in 5% debs.	£10,570 £21,550	... June & Dec.	3% 5%	... 100	5

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USEFUL INFORMATION RELATING TO ELECTRICAL LIMITED LIABILITY CONCERNS.—*Continued.*

Name of Company, Address of Office, and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called up.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892.	Closing Quotation. 1893.
EASTERN TELEGRAPH COMPANY, LIMITED, Winchester House, E.C. (6 June, 1872.)	Sir John Pender, G.C.M.G., M.P. (*Chn.*), Marq. of Tweeddale, George G. Nicol, Sir Albert J. Leppoc Cappel, K.C.I.E., Lord Sackville A. Cecil, C. W. Stronge, C.B., J. Denison Pender (*Man. Dir.*). *Secretary*, G. Draper.	£4,000,000 in £10 ord. £700,000 in 6% £10 pref. £103,200 in 5% debs. £1,296,785 in 4% deb. stock.	£4,000,000 £700,000 £103,200 £1,296,785	Quarterly Quarterly Feb. & Aug. May & Nov.	6½% 6% 5% 4%	14⅝-14⅞ 16-16½ 107-110 109-112	15-15¼ 15¾-16¼ 108-111 114-117
EASTERN EXTENSION, AUSTRALASIA AND CHINA TELEGRAPH COMPANY, LIMITED, Winchester House, E.C. (Reg. 1873.)	Sir John Pender, G.C.M.G., M.P. (*Chn.*), F. A. Bevan, Sir A. J. Leppoc Cappel, K.C.I.E., Charles W. Earle, Viscount Monck, George G. Nicol, J. Denison Pender, Marquis of Tweeddale. *Secretary*, F. E. Hesse.	£3,000,000 in £10 shrs. £640,000 in 5% debs. 4% mort. deb. stock	£2,500,000 £320,800 £320,000	Quarterly Jan. & July Feb. & Aug.	8¼% 5% 4%	14¾-15 104-107 109-112	15¼-15¾ 103-106 114-117
EASTERN AND SOUTH AFRICAN TELEGRAPH COMPANY, LIMITED, Winchester House, E.C. (19 August, 1879.)	Sir John Pender, G.C.M.G., M.P. (*Chn.*), Adm. Sir L. G. Heath, K.C.B., Sir Robert G. W. Herbert, G.C.B., C. W. Stronge, C.B., J. Denison Pender (*Man. Dir.*). *Secretary*, G. Draper.	£600,000 in £10 shares £600,000 in 5% mort. dbs. (1st issue £550,000) £300,000 in 4% mort. debs. £200,000 in £25 4% mort. debs.	£600,000 £224,200 £300,000 £200,000	... Jan & July Feb. & Aug. May & Nov.	10% 5% 4% 4%	... 103-106 103-106 ...	... 103-106 103-106 106-109
EASTON AND ANDERSON, LIMITED, 3, Whitehall-place, S.W. (4 June, 1888.)	T. P. Wilson (*Chn.*), W. Dickinson (*Vice*), E. W. Anderson, H. R. Bruxner, J. E. Compton-Bracebridge, C. H. Moberly. *Secretary*, J. M. Hamilton.	£206,000 in £100 ord. £44,000 in £100 5% prf.	£206,000 £18,400	...	...	...	...
ECUADOR TELEPHONE COMPANY, LIMITED, 42, Old Broad-street, London, E.C. (4 July, 1889.)	T. Greenwood (*Chn.*), Frank W. Jones, G. R. Upton. *Secretary*, Edmund Petley.	£100,000 in £5 shares	£50,000 (first issue)	...	..	...	...
EDINBURGH ELECTRIC SUPPLY CORPORATION, LIMITED—*in Liquidation*							
EDISON AND SWAN UNITED ELECTRIC LIGHT COMPANY, LIMITED, 100, Victoria-street, S.W. (26 Oct., 1883.)	J. Staats Forbes (*Chn.*), Major S. Flood Page (*Vice-Chn.*), Earl of Lichfield, S. Bidwell, F.R.S., E. Villiers. *Secretary*, H. Charles Gover.	£750,000 in £5 A shares £250,000 in £5 B shares	£532,000 £117,820	Feb. & Aug. Feb. & Aug.	12⅞% 3%	...	...
EDISON-GOWER-BELL TELEPHONE COMPANY OF EUROPE, LIMITED, 53, New Broad-street, E.C. (28 Oct., 1881.)	Sir A. Armstrong, K.C.B., (*Chn.*), A. H. Baker, C. L. W. FitzGerald. *Secretary*, R. Rodgers.	£480,000 in £1 ord. £20,000 in 5% pref.	£385,005 £20,000	..	...	...	...
EDMUNDSONS, LIMITED, 19, Great George-street, Westminster, S.W. (5 Nov., 1888.)	J. R. Wigham (*Chn.*), J. W. Edmundson, F. E. Gripper, H. Wigham. *Secretary*, F. A. Jones.	£65,000 in £10 shares	Fully paid	Yearly	6% ...	...	... ...
ELECTRIC ARMS AND AMMUNITION SYNDICATE, LIMITED, 35, Queen Victoria-street, E.C. (9 Oct., 1889.)	*Secretary*, W. F. Branston.	£40,000 in £100 shares	£26,600	...	...	...	...

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ELECTRIC AND AUTOMATIC ENGINEERING COMPANY LIMITED. (15 July, 1893.)	.....	£10,000 in £1 shares	.....	...	...	...	...
ELECTRIC CONSTRUCTION COMPANY, LIMITED, Queen-street-chambers, Queen-street, London, E.C. (29 May, 1889, 20 July, 1893.)	Sir Daniel Cooper, Bt., G.C.M.G. (*Chn.*), Rt. Hon. D. Plunket, Q.C., M.P., Sir H. C. Mance, C.I.E., J. W. Barclay, P. E. Beachcroft, J. Irving Courtenay, James Pender. *Man. Dir.*, Emile Garcke. *Works Dir.*, Thomas Parker. *Sec.*, James Gray.	£300,000 in £2 ord. £100,000 in 7% pref. £150,000 in 1st mrt. deb. £100,000 in 2nd mt. deb.	£240,000 £25,690 £125,400 £50,000 (£2,080 reds.)		...	...	½-1
ELECTRIC CYCLE SYNDICATE, LIMITED, 37, Walbrook, E.C. (12 April, 1892.)	*Secretary*, V. C. Doubleday.	£3,000 in £1 shares	£1 381 10s.	...	...	...	...
ELECTRIC EXPLOITATION COMPANY, LIMITED, (4 January, 1894.)	John A. Buchanan and V. C. Doubleday.	£25,000 in £1 shares	.....	...	...	...	...
ELECTRIC FITTINGS HIRING AND MAINTENANCE COMPANY, LIMITED, 21, Lime-street, E.C. (6 Jan., 1892.)	.....	£200,000 in £5 shares £500 in £1 founders'	.....	...	...	...	...
ELECTRIC & GENERAL CONTRACT CORPORATION, LIMITED, 35, Parliament-street, S.W. (25 Nov., 1892.)	William S. Graff Baker, Alfred de Turckheim. *Secretary*, A. Grosvenor Jones.	£45,000 in £5 pref. £5,000 in £5 def.	£4,025 £5,000	...	...	...	...
ELECTRIC AND GENERAL INVESTMENT COMPANY, LIMITED, 1 and 2, Great Winchester-street, E.C. (20 May, 1890.)	Geo. Herring (*Chn.*), Lord Cloncurry, J. B. Braithwaite, jun., B. H. Van Tromp, Emile Garcke (*Man.*). *Secretary*, J. Cecil Bull.	£199,500 in £5 ord. £500 in £5 founders'	£20,000 £500	May & Nov. May & Nov.	10% in. Nov.'93 £30 ('92-93)	1¾-2¼ £150-£200	...
ELECTRIC LAMP COMPANY, LIMITED, 26, Thavies' Inn, Holborn, E.C. (28 June, 1892.)	*Secretary*, — Goulston.	£5,000 in £1 shares	£2,797	...	...	...	...
ELECTRIC LIGHTING AND GENERAL DEVELOPMENT SYNDICATE, LIMITED, 31, Crutched Friars, E.C. (21 March, 1892.)	William Warriner, E. J. Rhodes, G. Morison. *Secretary*, William J. Whelan.	£700 in £10 shares	.. ...	...	...	...	...
ELECTRIC LIGHT REGULATING SYNDICATE, LIMITED, 8, Broad-street-avenue, E.C. (25 April, 1893.)	.....	£1,000 in £1 shares	£865	...	..	...	...
ELECTRIC METER COMPANY, LIMITED, 25, College-hill, E.C. (22 March, 1890.)	.....	£50,000 in £10 shares	.....	..	..	...	...
ELECTRIC SEMAPHORE SIGNAL SYNDICATE, LIMITED. (9 March, 1893.)	.....	£3,000 in £1 shares	.....	...	...	...	...
ELECTRIC TRAMWAYS CONSTRUCTION AND MAINTENANCE COMPANY, LIMITED, Royal Insurance-buildings, Halifax. (8 Dec., 1886.)	A. J. Lambert, A. G. Bolton, G. F. Fry, Col. F. C. Maude, V.C., C.B., T. Shaw, W. Ward, M. Holroyd Smith (*Man.*).	£250,000 in £1 shares	.....	...	..	...	..
ELECTRIC TRUST, LIMITED, 17, Parliament-street, Westminster, S.W. (24 June, 1889.)	*Secretary*, Edward Mann.	£60,000 in £10 shares £200 in £1 founders'	£16,750 £167	...	...	...	...
ELECTRIC WELDING COMPANY, LIMITED, 6, Great George-street, Westminster, S.W. (1 May, 1890.)	Sir G. B. Bruce (*Chn.*), Capt. A. H. Chapman, J.P., W. F. Gooch, J.P., Jos. Kincaid, M.I.C.E., M. F. Armstrong (*Man.*), William Parker. *Secretary*, G. Ensor Mount.	£450,000 in £10 ord. £10,000 in £10 fndrs'.	£183,332 £10,000	...	...	...	...
ELECTRIC WIRING AND FITTINGS COMPANY, LIMITED, 42, Duke-street, St. James's, S.W. (11 Sept., 1889.)	*Man. and Sec.*, George W. Green.	£5,000 in £1 shares	£2,882	...	...	...	..

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USEFUL INFORMATION RELATING TO ELECTRICAL LIMITED LIABILITY CONCERNS.—*Continued.*

Name of Company, Address of Office, and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called up.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892.	Closing Quotation. 1893.
ELECTRICAL ACCESSORIES COMPANY, LIMITED, 110, Charing Cross-rd., W.C. (28 Sep., 1889.)	*Man. Dir.*, C. L. Schwind.	£5,000 in £1 shares	£2,257	...	...	...	...
ELECTRICAL ADVERTISING SYNDICATE, LTD., 11, King William-street, E.C.	. ....	£10,000 in £10 shares	.....	...	...	...	..
ELECTRICAL COAL-CUTTING CONTRACT CORPORATION, LIMITED, 2, St. Nicholas-bldgs., Newcastle-upon-Tyne. (18 June, 1892.)	Lord Blythewood, W. T. Goolden, J. R. Knowles, F. Stobart, J.P., Hon. G. W. Winn, Lindsay Wood, J.P. *Secretary*, J. A. Pendlington.	£300,000 in £5 ord. £100,000 in £5 def. £2,000 in £1 founders'	£47,655 £100,000 £2,000	...	...	...	...
ELECTRICAL COMPANY, LIMITED, 122 and 124, Charing Cross-road, W.C. (13 July, 1892.)	Franz Deutsch, Felix Deutsch. *Gen. Man. and Sec.*, F. T. Eggers.	£15,000 in £5 shares	£12,000	...	...	...	...
ELECTRICAL ENGINEERING COMPANY OF IRELAND LIMITED—*in liquidation.*							
ELECTRICAL FINANCE CORPORATION, LIMITED, 22, Great George-street, Westminster, London, S.W. (18 Nov., 1891.)	C. E. Baker, *Secretary.*	£99,000 in £5 ord. £1,000 in £5 founders'	.....	...	...	...	...
ELECTRICAL INSTALLATION COMPANY, LIMITED, 64, Victoria-street, S.W. (27 May, 1892.)	E. W. H. Fyers, John G. O'Brien, E. L. O'Brien. *Man.*, J. G. O'Brien.	£1,800 in £1 A shares £1,100 in £1 B shares	£1,800 £1,100	...	...	...	...
ELECTRICAL INVENTIONS COMPANY, LIMITED, 57, Moorgate-street, E.C. (18 Sept., 1890.)	.....	£35,000 in £1 shares	.....	...	...	...	...
ELECTRICAL PLANT, LIMITED, 52, Queen Victoria-street, E.C. (27 Feb., 1892.)	H. Sherley-Price, W. R. Goulty, H. Cuthbert Hall.	£10,000 in £10 shares	.....	April.	...	...	...
ELECTRICAL POWER STORAGE COMPANY, LTD., 4, Great Winchester-street, E.C. (3 Dec., 1889.)	J. Irving Courtenay (*Chn. and Man. Dir.*), Sir Daniel Cooper, Bt., G.C.M.G., Frederick Green, James Pender. *Man.*, Frank King. *Sec.*, J. W. Barnard.	£100,000 in £5 ord. £500 in £5 founders'	£86,211 £350	...	5%	...	...
ELECTRICAL PURIFICATION ASSOCIATION, LIMITED, 19B, King-street, Westminster. (23 June, 1888.)	*Secretary*, Edward C. Davis.	£25,000 in £1 shares	£18,226	...	...	...	...
ELECTRICAL STANDARDISING, TESTING, AND TRAINING INSTITUTION, LIMITED—*struck off the Register.*							
ELECTRICAL SUPPLIES AND FITTINGS COMPANY, LIMITED—*in liquidation.*							
ELECTRICAL WORKS CONSTRUCTION AND MAINTENANCE COMPANY, LIMITED—*struck off the Register.*							
ELECTRICITY SUPPLY COMPANY FOR SPAIN, LIMITED, 15, St. Helen's-place, E.C. (7 June, 1889.)	Lord Castletown (*Chairman*), E. F. G. Hatch, John Annan, W. F. Leese, R. C. Wyatt. *Secretary*, P. A. Latham.	£99,500 in £5 ord. £500 in £5 founders' £25,000 in 5% prior lien bonds [dbs. £75,000 in 6% 1st mrt. £40,000 in 7% 2nd do.	£99,500 £500 £25,000 £75,000 £40,000	... Jan. & July Jan. & July Jan. & July	... 5% 6% 7%	.. ..	.. ..
ELECTROLYTIC CAUSTIC SODA AND CHLORINE TRUST, LIMITED, 23, Queen Victoria-street, E.C. (15 June, 1891.)	Col. T. J. Holland, C.B., J.P., Alderman and Sheriff G. R. Tyler, R. C. Baxter, C. E. Green, R. Vogan. *Secretary*, J. A. J. Shaw.	£12,500 in £10 shares	£9,000	...	...	...	...

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ELECTROLYTIC SEPARATION SYNDICATE, LTD. 42, Old Broad-st., E.C. (11 March, 1893.)	*Secretary*, H. S. Baker.	£45,000 in £1 ord. £5,000 in £1 pref.	.....	...	...	...	...
ELECTRO PROTECTOR SYNDICATE, LIMITED. (16 Sept., 1893.)	Thomas Beard, A. H. Macnaughten, E. S. Claremont, H. E. Saunders.	£10,000 in £1 shares	.....	...	...	...	..
ELLESON ACCUMULATOR (BRITISH PATENT) SYNDICATE, LIMITED, 6, Great Winchester-street, E.C. (13 Oct., 1892.)	R. R. Hutchinson, Watson Smith, F. C. Smith, E. Spendlove, Stanley W. Smith. G. S. Ridley H. Arthur Davis.	£12,000 in £1 shares	£1,003 10s	...	...	...	..
ELMORE'S PATENT COPPER DEPOSITING COMPANY, LIMITED, Pontefract-road, Leeds. (18 Jan., 1889.)	J. Todhunter, J. H. Dale, O. Jones. *Managers*, F. and S. Elmore. *Secretary*, L. J. Langmead.	£200,000 in £2 shares	£182,390	...	...	$\frac{5}{8}$-$\frac{7}{8}$	$\frac{1}{8}$-$\frac{3}{8}$
ELMORE'S FOREIGN AND COLONIAL PATENT COPPER DEPOSITING COMPANY, LIMITED, 5, Laurence Pountney-hill, E.C. (6 June, 1889.)	W. Elmore J. J. Atkinson, F. L. Rawson. *Secretary*, J. Shurmer.	£75,000 in £5 priority £45,000 in £5 founders'	£75,000 £45,000	...	100%	..	...
ELMORE'S AMERICAN AND CANADIAN PATENT COPPER DEPOSITING COMPANY, LIMITED, 5, Laurence Pountney-hill, E.C. (26 Jan., 1892.)	J. A. Ewen, J. J. Atkinson, J. T. Cooper. *Secretary*, J. Shurmer.	£130,000 in £2 priority £70,000 in £2 deferred	£89,576 £70 000	...	...	...	..
ELMORE'S FRENCH PATENT COPPER DEPOSITING COMPANY, LIMITED—*in liquidation.*	.....	.....	... ..	...	...	...	..
ELMORE'S GERMAN AND AUSTRO-HUNGARIAN METAL COMPANY, LIMITED, Broad-street-avenue, E.C. (26 Sept., 1890.)	J. Rock (*Chn.*), J. Macfarlan, Lt.-Gen. G. H. Fraser. *Secretary*, H. Ellis.	£250,000 in £2 ord. £50,000 in £2 7% prf.	£150,000	...	...	...	...
ELMORE'S WIRE MANUFACTURING COMPANY, LIMITED, Pontefract-road, Leeds. (15 Mar., 1890.)	J. J. Atkinson, J. T. Cooper, W. Elmore. *Managers*, F. and E. Elmore. *Secretary*, J. Shurmer.	£300,000 in £2 ord. £20 in £2 founders'	£138,770 £20	..	...	$\frac{3}{4}$	...
ENGLISH ELECTRIC CARBON COMPANY, LTD., Carbon Works, Brymbo, near Wrexham. (18 March, 1893.)	J. H. Darby (*Chn.*), Sir H. B. Robertson, J. C. Edwards, W. Darby, Emil Mahla. *Sec. and Man.*, T. G. Litt\eboy.	£10,000 in £10 shares	£3,845	...	...	...	...
ENGLISH ELECTRIC MANUFACTURING COMPANY, LIMITED. (23 Oct., 1893).	Joseph Hales, *Chn.*	£5,000 in £1 shares	.....	...	...	...	...
EPSTEIN ELECTRIC ACCUMULATOR COMPANY, LIMITED, 213, Gresham House, Old Broad-street, E.C. (31 July, 1891.)	*Man. Dir.*, Ludwig Epstein. *Manager*, Louis Broekman. *Secretary*, F. R. Bluett.	£100,000 in £1 ord. £1,000 in £1 founders'	£70,367 £1,000	...	... ...	...	...
EUROPE AND AZORES TELEGRAPH COMPANY, LIMITED, Winchester House, Old Broad-street, E.C. (19 Aug., 1893.)	Sir John Pender, G.C.M.G. M.P., Marquis of Tweeddale, T. Fuller, J. Denison Pender. *Secretary*, George R. Neilson.	£200,000 in £10 shares	£167,000	...	...	...	...
EUROPEAN SIMS-EDISON ELECTRICAL TORPEDO COMPANY, LIMITED, 9, Fenchurch-avenue, E.C. (9 May, 1891.)	Major J. F. C. Hamilton (*Chn.*), E. Frazar, W. S. Sims, E. M. Fox, Maj.-Gen. A. H. Elliott, C.B., Capt. H. F. Twynam, Major F. J. Murphy. *Sec.*, T. Dundas Pillans.	£200,000 in £20 ord. £1,000 in £1 founders'	£157,600 £1,000	...	..	...	...
EXCHANGE TELEGRAPH COMPANY, LIMITED, 17 and 18, Cornhill, E.C. (28 March, 1872.)	Lord Sackville Cecil (*Chn.*), Sir M. Kennedy, Kenneth Anderson, Hon. Schomberg Kerr McDonnell, W. H. Davies (*Man.*) *Secretary*, W. King.	£165,000 in £10 ord. £81,250 in 10% £10 pref. (£9 paid)	£165,000 £73,125	...	4%	...	...
EXETER ELECTRIC LIGHT COMPANY, LIMITED, Rockfield Works, Exeter. (9 Mar., 1888.)	W. Horton Ellis, J.P. (*Chn.*), L. J. Kennaway, A. E. Mavor, G. F. Truscott, A. Woodgates. *Secretary*, E. J. Rigby.	£14,900 in £10 ord. £5,000 in 6% pref. £100 in £10 founders'	£10,900 £100	...	...	...	....

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Name of Company, Address of Office, and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called up.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892.	Closing Quotation. 1893.
FARADAY ELECTRICAL ENGINEERING CO., LTD., Campbell-st, Govan, Glasgow. (Sept., 1893.)	Peter Galbraith, James Johnstone, and John Macdonald. *Manager*, William M'Whirter.	£4,600 in £1 shares	.....	...	...	...	...
FAREHAM ELECTRIC LIGHT COMPANY, LIMITED, Gosport-road, Fareham. (8 Feb., 1890.)	Capt. Ramsay (*Chn.*), Admiral Townsend, E. Arnold, T. Caute, E. Caute, J. Blake (*Man.*) *Secretary*, Arthur Blake.	£5,000 in £1 shares £2,500 in 5 % debs.	£4,158	...	...	...	..
FERRANTI (S. Z. DE), LIMITED, 27, Charterhouse-square, E.C. (26 June, 1890.)	S. Z. de Ferranti, H. P. Sparks, F. Ince.	£80,000 in £10 ord. £20,000 in £10 7% pref.	£80,000 £20,000	...	...	...	...
FORD-LLOYD MANUFACTURING CO, LTD., Mount Pleasant, Clerkenwell, E.C. (7 June, 1893.)	E. J. Tumber, A. Ford-Lloyd, and C. H. Elliot.	£10,000 in £1 shares	.....	...	...	...	...
FOREIGN AND COLONIAL ARC ACCUMULATOR COMPANY, LIMITED, 19A, Coleman-street, E.C. (14 May, 1891.)	.....	£1,000 in £1 shares	.....	..	...	...	...
FORRION PILSEN ELECTRIC LIGHT AND POWER COMPANY, LIMITED, 11, Abchurch-lane, E.C. (20 Jan., 1885.)	J. Goddard, A. Parrish, and D. Parrish. *Secretary*, C. Akers.	£30,000 in £1 shares	£29,800	April	2½%	...	...
FOWLER (JOHN) AND CO., LEEDS, LIMITED, 6, Lombard-street, E.C. (13 Aug., 1886.)	W. Fowler (*Chn.*), R. H. Fowler, A. Fowler, R. W. Eddison, R. Wigram. *Secretary*, W. McIntosh.	£500,000 in £10 pref. £180,000 in £10 ord.	£284,430 £180,000	...	...	...	...
FOWLER, LANCASTER AND COMPANY, LIMITED—*in liquidation.*							
FOWLER-WARING CABLES COMPANY, LIMITED, 32, Victoria-street, S.W. (13 Aug., 1889.)	W. Fowler (*Chn.*), W. Chamberlain, G. Fleming, R. W. Eddison, Lord Medway, G. F. Smart. *Gen. Man.*, A. E. Mavor. *Secretary*, D. Stephen.	£198,500 in £5 ord. £1,500 in £5 founders' £10,000 in £100 debs.	£100,000 £1,500 £5,500	...	...	2-3	½-1½
FROGGATT'S INVENTIONS SYNDICATE, LIMITED. (1 Jan., 1894.)	.....	£500 in £1 ord. £500 in £1 pref.	.....	...	...	...	...
GENERAL ELECTRIC COMPANY, LIMITED, 71, Queen Victoria-street, E.C. (25 July, 1889.)	G. Binswanger (*Man.*), Max Binswanger, H. Hirst.	£20,000 in £5 ord. £35,000 in £5 1st pref. £5,000 in £5 2nd pref.	£20,000 £31,625 £5,000	...	...	...	...
GENERAL ELECTROLYTIC PARENT COMPANY, LIMITED. (31 July, 1893.)	.....	£24,000 in £1 shares.	.....	...	...	...	...
GIANT'S CAUSEWAY, PORTRUSH AND BUSH VALLEY RAILWAY AND TRAMWAY COMPANY, LIMITED, Portrush, Antrim. (26 Aug., 1880.)	Dr. Anthony Traill (*Chn.*), J. Stewart Moore. *Secretary*, D. Fall, junr.	£75,000 in £10 shares and loans	£20,500 £12,700 (loans)	..	...	...	...
GLOBE ELECTRIC COMPANY, LIMITED, 12, Ropemaker-street, E.C. (4 Nov., 1891.)	.....	£10,000 in £1 shares	£5,607	...	...	...	...
GLOBE TELEGRAPH AND TRUST COMPANY, LIMITED, Winchester House, E.C. (11 July, 1873.)	Sir John Pender, G.C.M.G., M.P. (*Chn.*), Lord Sackville A. Cecil, Sir H. D. Gooch, Bart., James Pender, Marquis of Tweeddale, Hon. W. St. John Brodrick, M.P. *Secretary*, Sidney Collett.	£2,500,000 in £10 ord. £2,500,000 in £10 pref.	£1,802,270 £1,800,420	Quarterly Quarterly	4⅝% 6%	9¾-10 14¼-15⅛	8⅞-8⅞ 15⅛-15⅝

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GORDON ELECTRIC TRACTION SYNDICATE, LIMITED, 49, Greenwich-road, S.E. (13 Aug., 1890.)	W. Lüttze, J. C. Merryweather, E. P. Williams, A. F. Koebel, J. M. V. Money-Kent. *Managing Director and Secretary*, John Gordon.	£2,400 in £10 shares	£2,330	...	...	...	...
GORSEINON ELECTRIC LIGHT CO., LIMITED, Gorseinon, near Swansea. (17 Nov., 1893.)	... ..	£1,000 in £1 shares.	.....	...	...	...	...
GRAVIER DYNAMO SYNDICATE, LIMITED, 11, Colby-road, Upper Norwood, Surrey. (13 July, 1893.)	.. ...	£10,000 in £1 shares.	.....	...	...	...	..
GREAT NORTHERN TELEGRAPH COMPANY OF COPENHAGEN, 26, Kongens Nytorv, Copenhagen, and 3, St. Helen's-place, E.C. (Inc. 1869.)	C. F. Tietgen (*Chn.*), C. St. A. Bille, Col. V. Hoskiœr, M. Melchior, Comm. E. Suenson (*Man. Dir.*), F. C. Tobiesen. Vice-Adm. J. Meldal. *London Man. and Rep. in England*, F. C. C. Nielsen.	£1,500,000 in £10 shrs. £300,000 in 5% debs.	£1,500,000 £200,000	Half-yearly Mar. & Sept.	8⅓% 5%	19¼-⅜ 104-107	20-20½ 104-107
GREENWOOD AND BATLEY, LIMITED, 16, Great George-street, S.W. (7 July, 1888.)	*Man. Dirs.*, A. Greenwood (*Chn.*), G. Greenwood, H. Greenwood, J. H. Wurtzburg. *Dirs.*, Vice-Adm. P. H. Colomb, Major-General E. Micklem, Lt.-Col. R. Vivian. *Secretary*, George Hagger.	£260,000 in £10 ord. £140,000 in £10 7% pref. £100,000, in 5 % debs.	£180,520 £110,660 £80,000	... July 1 Apr., 1 Oct.	... 7% 5%	4⅞ 8⅛	5 6½
GÜLCHER (NEW) ELECTRIC LIGHT AND POWER COMPANY, LIMITED, Battersea Foundry, S.W. (28 Feb., 1888.)	D. de Castro (*Chn.*), H. Grëwing, W. O. Rooper, Captain W. S. Levett, R. Pryor. *Manager*, W. B. Esson. *Secretary*, T. C. Morgan.	£50,000 in £1 pref. shs. £20,000 in £1 def. £8,000 in 6% 1st mort. debs. £5,000 in 6% 2nd mort. debs.	£43,807 10s. £20,000 £8,000 £5,000	... ...	none 6%	...	...
HALIFAX AND BERMUDAS CABLE COMPANY, LTD., 33, Old Broad-st., E.C. (22 May, 1889.)	T. Skinner (*Chn.*), T. G. H. Glynn, C. R. Hosmer, Joseph Rippon (*Gen. Man.*)	£50,000 in £5 shares £120,000 in 4½% debs.	£50,000 £120,000	...	.. 4½%	...	...
HALIFAX MUTUAL ELECTRIC LIGHT AND POWER COMPANY, LIMITED.—*In liquidation.*							
HASTINGS AND ST. LEONARDS-ON-SEA ELECTRIC LIGHT COMPANY, LIMITED, 20, South-terrace, Earl-street, Hastings. (7 March, 1882.)	H. M. Baker (*Chn.*), F. A. Langham, F. Noakes, F. J. Parsons, J. Reeves, G. Roddis, J. Woodhams. *Secretary*, F. E. Burton.	£50,000 in £10 shares £4,175 in 5 % debs. (£5,000 authorised)	£16,670 £4,175	April	7½%	...	..
HEMMING (T. L.) AND COMPANY, LIMITED, 88, Snow-hill, Birmingham.	.....	£5,000 in £10 shares	£4,210	...	...	...	...
HENLEY'S (W. T.) TELEGRAPH WORKS COMPANY, LIMITED, 27, Martin's-lane, E.C. (21 Feb., 1880.)	S. Gedge, (*Chn.*), Maj.-Gen. G. Hutchinson, C.B., C.S.I., R. J. Jenkins, F. Newton, Hon. R. Stewart. *Man. Dir.*, G. Sutton.	£70,000 in £10 ord. £30,000 in £10 7% pref. £15,000 5½% debs. £12,000 6% debs.	£68,370 £30,000 £15,000 £12,000	.. ...	5% 7%	... ...	... ...
HERCULITE AND ELECTRICAL MANUFACTURING COMPANY, LTD., 28B, Bower-road, Victoria Park, N.E. (11 Jan., 1893.)	.....	£8,000 in £1 ord. £4,000 in £1 10% pref.	£1,958 £4,000	...	...	...	...
HOBART ELECTRIC TRAMWAY COMPANY, LIMITED, College Hill-chambers, Cannon-street, E.C. (4 Mar., 1892.)	Alfred Mattei, LL.D., J. C. Bellamy, D. J. Mackay, Sir Edward N. C. Braddon, K.C.M.G., C. Barclay, J. W. Syme, Hon. C. H. Grant. *Secretary*, W. R. Harrower.	£105,000 in £1 shares £30,000 in £20 5% 1st mort. deb. bonds £15,000 in £20 5% 2nd mort. deb. bonds	£45,000 £30,000 £15,000	...	...	...	...

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USEFUL INFORMATION RELATING TO ELECTRICAL LIMITED LIABILITY CONCERNS.—*Continued.*

Name of Company, Address of Office and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called up.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892.	Closing Quotation. 1893.
HOLLOWAY ELECTRICITY SUPPLY COMPANY, LTD., 34, Victoria-st, S.W. (30 June, 1892.)	.....	£2,000 in £10 shares	.....	...	...	..	...
HOME TELEPHONE COMPANY, LIMITED, 85, Queen Victoria-st., E.C. (27 July, 1891.)	.....	£500 in £5 shares	£200	...	...	..	...
HONGKONG ELECTRIC COMPANY, LIMITED, Hongkong.	H. L. Dalrymple (*Chn.*), Hon. C. P. Chater, T. E. Davies, J. J. Bell-Irving, J. Kramer. *Man.*, W. H. Wickham. *Sec.*, C. F. Harton.	$300,000 in $10 shares	$240,000	...	...	3/-	...
HOPE-JONES ELECTRIC ORGAN COMPANY, LTD., 4, Huggin-lane, E.C. (1 July, 1892.)	Thomas Threlfall, G. A. W. Beard, W. Creser, W. D. Hall, R. Hope-Jones.	£13,000 in £10 ord. £12,000 in £10 pref.	£13,000 £6,775	...	...	..	...
HOUSE-TO-HOUSE ELECTRIC LIGHT SUPPLY COMPANY, LIMITED, Richmond-road, S.W. (20 Feb., 1888.)	H. R. Beeton (*Chn.*), W. R. Davies, W. F. Leese, R. A. Germaine, W. Page, Robert Hammond (*Man. Dir.*) *Secretary*, W. Coupland Weir.	£289,500 in £5 ord. (First issue £175,000) £60,000 in £5 pref. £500 in £5 founders' £30,000 (out of £100,000 auth.) in 6 % debs.	£41,610 £25,000 £500 £30,000	... Yearly Jan. & July	... 7% 6%	1¼-2½ ...	... ...
HOVE ELECTRIC LIGHTING COMPANY, LIMITED, Mansion House-buildings, E.C. (4 Aug., 1892.)	Col. A. J. Filgate, R.E. (*Chn.*), Col. H. Wood, C.B., H. A. Hoare, C. F. Tufnell, J. Wilkes. *Sec.*, F. R. Reeves. *Local Sec.*, T. L. R. Cooper	£40,000 in £5 shares	£16,450	...	...	...	...
HULETT (D.) AND CO., 55, High Holborn, W.C. (30 July, 1889.)	W. Benson (*Chn.*)	£34,500 in £5 ord. £500 in £5 founders'	£34,500 £500	...	...	...	...
INDIA RUBBER, GUTTA PERCHA AND TELEGRAPH WORKS COMPANY, LIMITED, 106, Cannon-street, E.C. (25 March, 1864.)	S. W. Silver (*Chn.*), A. Scott, R. Henderson, Hon. H. Marsham, A. W. Jarvis, M. Gray (*Man.*) *Secretary*, W. J. Tyler.	£812,000 in £10 shrs. £200,000 in 4½ % debs.	£500,000 £200,000	Feb. & Aug. Mar. & Sept.	10% (int.) ...	21¾-22¼ 102-4	21½-22½ 102-4
INDO-EUROPEAN TELEGRAPH COMPANY, LIMITED, 18, Old Broad-street, E.C. (8 Apr., 1868.)	J. H. Tritton (*Chn.*), L. Delbrück, C. W. Earle, J. von Berenberg Gossler, C. Holland, H. H. Meier, Major-Gen. G. B. Tremenheere, W. Andrews (*Man.-Dir.*) *Secretary*, F. Moll.	£450,000 in £25 shares	£425,000	May & Nov.	5% (int.)	44-46	40-3
INTERNATIONAL CABLE COMPANY, LIMITED—	*in liquidation.* *Liq.*, J. Lord, 3, Bucklersbury, E.C.						
INTERNATIONAL ELECTRIC SUBWAY COMPANY, LIMITED, 39, Victoria-street, S.W. (17 Nov., 1891.)	John L. Martin (*Chn.*), Major Torkington, F. W. Toppan, T. Ernest Polden, M. R. Margesson (*Man.*). *Secretary*, Theo. J. Ford.	£25,000 in £1 shares	£21,907 issued as fully paid	...	...	...	...
INCANDESCENT ELECTRIC LAMP COMPANY, LTD., 71, Queen Victoria-st., E.C. (25 July, 1893.)	James Fraser, Gustav Binswanger, C. J. Robertson (*Works Manager*).	£25,000 in £10 shares	.....	...	...	...	...
ISLE OF WIGHT ELECTRIC LIGHTING COMPANY, LIMITED, 21, Lime-street, London. (12 Nov., 1891.)	J. F. Albright, A. Palliser, jun., E. Stephen Revett. *Secretary*, F. R. Reeves.	£940 in £1 ord. £60 in £1 founders'	.....	...	...	...	...
ITALIAN ELECTRIC LIGHT AND POWER COMPANY, LIMITED, 10, Austin-friars, E.C. (17 July, 1891.)	.....	£60,000 in £4 shares	£8,172	...	...	...	...

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J. C. Howell, Limited, 24, Queen Victoria-street, E.C. (9 July, 1892.)	*Man. Dirs.*, John C. Howell and W. M. Meredith. *Secretary*, Percy E. Scrutton.	£25,000 in £5 shares	£14,535	...	...	...	...
Johannesburg Lighting Company, Limited, 6 Great Winchester-street, E.C. (1891.)	W. G. Soper (*Chn.*), W. M. Farmer, S. H. Hewitt, A. Jones, W. F. Lance (*Man.*). *Secretaries*, Messrs. Davis and Soper.	£85,000 in £1 ord. £15,000 in reserved £1 £50,000 in £1 pref. £60,000 in 7 % mort. debs.	£77,132 £15,000 £50,000 £60,000	...	...	...	...
Keighley Electrical Engineering Company, Limited, 8, Devonshire-street, Keighley.	.....	£10,000 in £1 shares	£4,083	...	...	...	..
Kelvinside Electricity Company, Limited, 28, Renfield-street, Glasgow. (28 June, 1889.)	James B. Fleming (*Chn.*), Hugh Beckett, James Reid, Hugh Steven, R. Paterson, J. M. V. Money-Kent (*Man. Director*). *Secretary*, W. Hannom Watson.	£50,000 in £1 shares £10,000 5% debs.	.....	..	...	...	.
Kennedy Storage Battery Company, Limited, Broad-street-house, Old Broad-street, E.C. (24 Aug., 1892.)	.....	£100,000 in £1 shares	£100,000	...	...	...	..
Kensington and Knightsbridge Electric Lighting Company, Limited, 148, Brompton-road, S.W. (29 March, 1888.)	Granville R. Ryder, Sir F. J. Bramwell, Bt., F.R.S., A. S. Bolton, G. H. Hopkinson, R. W. Wallace. *Secretary*, R. S. Erskine, M.I.E.E.	£250,000 in £5 ord. £50,000 in £5 1st pref. £50,000 in £5 2nd pref. 4½ % debs.	£75,000 £50,000 £7,260 £42,000	... Jan. & July Apr. & Oct. Feb. & Aug.	4% 6% 5%	5-5½ 6-6½	... ...
Keswick Electric Light Company, Limited, 19, St. John-street, Keswick. (1 May, 1889.)	W. P. J. Fawcus (*Man. Dir.*). *Secretary*, J. Broad.	£5,000 in £1 shares	£3,420	..	...	..	..
Laing, Wharton, and Down Construction Syndicate, Limited, 38, Parliament-street, S.W. (18 March, 1889.)	C. J. Wharton (*Chn.*), A. F. Davies, and W. B. H. Martindale. *Manager and Secretary*, J. Devonshire.	£70,000 in £10 ord. £30,000 in 5% pref. £10,000 in 6% debs. £25,000 in loans.	£45,160 ..... £10,000 £20,000	..	2½% (1891-92.)	...	..
Lamina Accumulator (Elieson's British Patents) Syndicate, Limited. (29 June, 1893.)	Earl of Galloway (*Chn.*), A. J. Morison, Moritz Immisch, F. A. Cellas, C. P. Elieson.	£12,000 in £1 shares	£1,000	...	..	...	..
Lancashire and Yorkshire Electric Lighting Company, Limited, 5 and 6, St. James's-square, Manchester.	.....	£100,000 in £5 shares	£317 10s.	..	..	..	..
Lancashire Electric and Engineering Company, Limited, 11, Chancery-lane, Bolton.	.....	£20,000 in £5 shares	£1,875	..	...	..	..
Latimer Clark, Muirhead and Co., Limited, 23, Regency-street, Westminster, S.W. (22 Oct., 1883.)	.....	£100,000 in £10 shares	£47,090	...	...	...	...
Laurence, Scott and Co., Limited, King-street, Norwich. (10 Aug., 1888.)	Reginald Laurence, W. H. Scott. *Engineer and Secretary*, W. B. Sisling.	£30,000 in £10 shares	£14,060	...	...	...	...
Leeds and London Electrical Engineering Company, Limited, 15, St. Helens-place, E.C.	.....	£50,000 in £5 ord. £48,750 in £5 pref. £1,250 in £5 founders'	£40 £3,270 £1,250	...	...	...	...

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Name of Company, Address of Office, and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called up.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892.	Closing Quotation. 1893.
LINEFF ELECTRIC TRACTION AND LIGHTING SYNDICATE, LIMITED, 90, Ladbroke-grove, W. (8 August, 1888.)	E. H. Bayley, M.P. (*Chn.*), J. Seymour Keay, M.P. *Secretary*, Robert Applegarth.	£15,000	£11,431	...	...	...	...
LIRONI & BOWMAN, LIMITED, Bow Electric Works, Arnold-st, Bow, E. (13 July, 1892.)	A. J. Hollington, T. W. Hollington, V. G. Lironi, J. J. Bowman.	£2,000 in £1 shares	£2,000	...	...	...	...
LITHANODE AND GENERAL ELECTRIC COMPANY, 11, Abchurch-lane, E.C. (8 July, 1892.)	*Gen. Man.*, J. T. Niblett. *Secretary*, J. H. Hays.	£100,000 in £1 shares	£25,947	...	...	...	...
LIVERPOOL ELECTRIC SUPPLY COMPANY, LIMITED, 15, Highfield-street, Liverpool. (10 Jan., 1883.)	A. H. Holme (*Chn.*), J. S. H. Banner, Sir D. Radcliffe, S. H. Holme, D. de Ybarrondo, Th. von Sobbe, J. C. Vaudrey. *Secretary*, B. H. Collins.	£150,000 in £5 shares (£3 10s. paid) £75,000 in £5 shares (fully paid) £75,000 in £5 shares	£180,000 Not yet issued	Mar. & Sept.	— 5%	3 7/8-3 1/4 5 7/8-5 7/8	4 1/2-3 3/4 6 1/2-1 1/2
LIVERPOOL OVERHEAD RAILWAY COMPANY, 24, North John-street, Liverpool. (Inc. 24 July, 1888.)	Sir W. B. Forwood (*Chn.*), J. Barrow, J. Brancker, H. Brocklebank, R. Hobson, E. Lawrence, G. H. Robertson. *Engineer and Manager*, S. B. Cottrell. *Secretary*, W. H. Alexander.	£450,000 in £10 shares £120,000 in £10 pref. £190,000 in debs.	£375,000 £100,000 £125,000	... ...	... 5%	.. ...	5–5 1/2 ...
LLANELLY ELECTRIC LIGHT AND POWER COMPANY, LIMITED, New Dock, Llanelly. (26 Oct., 1889.)	.....	£14,990 in B £1 shares £10 in A £1 shares	..... £7	...	...	...	...
LONDON BATTERY COMPANY, LIMITED—*in liquidation.*							
LONDON AND HAMPSTEAD BATTERY COMPANY, LIMITED, 15A, Fitzjohn's-pavement, Finchley-road, Hampstead, N.W. (13 May, 1892.)	*Manager*, A. W. Armstrong. *Engineer*, R. H. Howard.	£15,000 in £5 ord. £35,000 in 6% pref.	£15,000 £3,075	...	...	...	...
LONDON AND LANCASHIRE ELECTRIC AND GENERAL ENGINEERING COMPANY, LIMITED, Dalston, N.E. (27 February, 1893.)	*Man.*, C. N. Russell.	£20,000 in £5 shares	£6,572	...	...	...	...
LONDON ELECTRIC SUPPLY CORPORATION, 3, Adelphi-terrace, W.C. (26 Aug., 1887.)	J. S. Forbes (*Chn.*), Earl of Crawford, Hon. R. F. D. Brougham, F. Ince, Sir Coutts Lindsay, Bt., J. Pyke, Lord Wantage, K.C.B., V.C., Major C. B. Waller. *Gen. Man.*, H. F. Lewis. *Sec. and Accountant*, R. Stewart Bain.	£1,000,000 in £5 ord. £250,000 in £5 pref.	£555,000 £249,200	...	...	5/8-7/8	1/4-3/4
LONDON ELECTRIC WIRE COMPANY, LIMITED, Playhouse-yard, Golden-lane, E.C. (31 May, 1892.)	*Managing Director*, John Willey.	£25,000 in £5 ord. £25,000 in £5 pref.	£22,255 £20,690	...	...	...	...
LONDON PLATINO-BRAZILIAN TELEGRAPH COMPANY, LIMITED, 19, Great Winchester-street, E.C. (4 March, 1878.)	W. S. Andrews (*Chn.*), Lord R. H. Browne, C. W. Earle, D. H. Goodsall, J. Coppen, Major A. Wood (*Man.*) *Secretary*, R. M. Cunningham.	£400,000 in £10 shares £100,000 in 6% debs.	£375,480 £100,000	May & Nov. Mar. & Sept.	2% 6%	4-6 108-111	4-6 105-108

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MADRAS ELECTRIC TRAMWAYS COMPANY, LIMITED, 1, Northumberland-avenue, Charing Cross, W.C. (2 April, 1892.)	W. Digby, C.I.E., M. M. Bhownaggree, C.I.E., W. A. Gibson, A. J. Lusty, S. A. Chalk (*Man.*). *Secretary*, A. C. Colebrook Codd.	£100,000 in shares of £1 or Rs.15	15s. or Rs.10 per share	...	...	...	...
MANCHESTER EDISON-SWAN COMPANY, LIMITED, Temple-chambers, 29, Brazenose-street, Manchester. (23 May, 1882.)	V. K. Armitage (*Chn.*), F. B. Ross, I. C. Waterhouse, Major S. Flood Page, W. P. J. Fawcus (*Man. Dir.*) *Sec.*, J. E. Sharples.	£450,000 in £9 A shares (£180,000 issued)	£20,000	...	5%	3/9-4/3	3/-4/
MANITOBA ELECTRIC AND GAS LIGHT COMPANY OF CANADA, Winnipeg. (Inc. 1880.)	*Trustees for Bondholders*: L. R. C. Boyle. London Agents: R. A. McLean and Co., 1, Queen Victoria-street, E.C.	£100,000 in £10 B shares $500,000 in $50 shares £62,000 in 6 % debs.	£100,000 $200,000 £62,000	... ... Jan. & July	... ...	... ...	... ...
MARCHANT, YOUNG AND CO., LIMITED, 166, Clerkenwell-rd, E.C. (14 Sept., 1893.)	J. E. Marchant and Charles T. Young (*Man. Dirs.*), Bernard J. Young.	£4,000 in £1 shares	.....	...	...	...	...
MATHER AND PLATT, LIMITED, Salford Iron Works, Manchester. (4 May, 1892.)	*Man. Dirs.*, William Mather, M.P. (*Chn.*), John Platt, Edward Hopkinson, Thomas Thorp.	£200,000 in £10 shares	£135,000	...	...	...	...
MAZARRON ELECTRIC LIGHT COMPANY, LTD. (27 February, 1893.)	Walter B. Kingsford, Stanley W. Richard.	£10,000 in £1 ord. £5,000 in £10 8% debs.	.....	...	...	...	...
MERIONETHSHIRE ELECTRIC LIGHTING, POWER, AND APPLIANCE COMPANY, LIMITED. (9 June, 1893.)	J. C. Roberts, W. Williams, F. Whiteley, A. Thorburn, Henry May, and Dr. L. Williams.	£3,000 in £1 shares	.....	...	...	...	...
MERVEILLEUSE ELECTRIC ARC LAMP SYNDICATE, LIMITED. (24 April, 1893.)	.....	£15,000 in £1 shares	.....	...	...	...	...
METROPOLITAN ELECTRIC SUPPLY COMPANY, LIMITED, Winchester House, E.C. (26 Nov., 1887.)	Sir J. Pender, G.C.M.G., M.P. (*Chn.*), J. D. Pender (*Dep. Chn.*), Adm. Lord John Hay, G.C.B., Adm. Sir G. H. Richards, K.C.B., F.R.S., J. C. Parkinson, J. B. Verity, Sir Eyre M. Shaw, K.C.B. *Man.*, E. S. Claremont. *Secretary*, E. Cunliffe-Owen, C.M.G.	£499,000 in £10 ord. £1,000 in £10 founders' £100,000 in 5% debs.	£499,000 £1,000 £50,000	.. ...	4% ...	6½-7 102-105	7¾-8¼ 103-106
MEXICAN GAS AND ELECTRIC LIGHT COMPANY, LIMITED, 15, Bishopsgate-street Within, E.C. (24 April, 1883.)	.....	£100,000 in £20 shares	£100,000	...	...	...	...
MIDDLESBOROUGH ELECTRIC LIGHT, HEAT, AND POWER COMPANY, Middlesborough, Kentucky, U.S.A. London Office: Dashwood House, London, E.C. (March, 1890.)	*London Directors*: E. F. Powers (*Chn. and Man.*), N. J. Barron, F. B. May. *London Secretary*, Edward Johnson.	$250,000 in shares of $5	$175,000	...	...	...	...
MIDLAND ELECTRIC LIGHT AND POWER COMPANY, LIMITED, 33, Waterloo-street, Birmingham. (12 Dec., 1881.)	Arthur Chamberlain, J.P., G. Hookham, J.P. *Secretary*, J. Fellows.	£50,000 in £10 shares	£31,390	...	...	...	...
MIDLAND HOUSE-TO-HOUSE ELECTRICITY COMPANY, LIMITED, 39, Bennett's-hill, Birmingham. (26 June, 1889.)	*Secretary*, A. H. Gibson.	£99,500 in £5 ord. £500 in £5 founders'	.....	...	...	...	...
MINER'S LAMP ELECTRIC LIGHTING COMPANY, LIMITED, 118, Albion-street, Leeds. (12 Jan., 1889.)	.....	£3,000 in £5 shares	£1,505	...	..	...	...
MONTE VIDEO TELEPHONE COMPANY, LIMITED, 96, Gresham-house, Old Broad-street, E.C. (31 July, 1888.)	Herbert Ward (*Chn.*), C. H. Sanford, E. F. Powers (*Man.*) *Secretary*, E. M. Reiss.	£75,000 in £5 ord. £145,000 in 6% £5 prf.	£75,000 £140,000	... half-yearly	...	...	...

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USEFUL INFORMATION RELATING TO ELECTRICAL LIMITED LIABILITY CONCERNS.—*Continued.*

Name of Company, Address of Office, and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called up.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892.	Closing Quotation. 1893.
MONTREAL TELEGRAPH COMPANY, Montreal, Canada. (Inc. 1847.)	A. Allan (*Pres.*), H. Mackenzie, W. Wainwright, J. Joseph, H. Archbald, Wm. Rae & H. Yates. *Sec. and Treas.*, D. Ross-Ross.	$2,000,000 in $40 shares	$2,000,000	Jan., April, July, Oct.	8% (Guarant'd by W. Union Co.)	156½	...
MORECAMBE ELECTRIC LIGHT AND POWER COMPANY, LIMITED, 18, Crescent, Morecambe. (27 July, 1891.)	C. M. Mabbott, W. B. Hodgson, W. C. Farrar. *Secretary*, J. Jowett.	£14,950 in £1 ord. £50 in £1 founders' £2,500 in 5% mort. debs.	£5,529 £50 £1,500	Feb.	5%	...	...
MULHOLLAND, MAUGHAM AND CO., LIMITED, Ferryhill, Durham. (29 July, 1890.)	.....	£3,800 in £10 ord. £1,200 in £10 founders'	£835 £1,200	...	...	...	...
MUNICIPAL ELECTRIC LIGHT AND POWER CORPORATION, LIMITED, 33, Old Broad-street, London, E.C. (5 June, 1889.)	*Secretary*, Alfred Aylard.	£24,900 in £10 ord. £100 in £1 founders'	£370 £30	...	...	...	...
MUNRO'S ELECTRICAL MANUFACTURING COMPANY, LIMITED, 9, Holland-place, Glasgow. (11 Oct., 1889.)	J. M. M. Munro (*Man.*)	£20,000 in £10 shares.	£9,430	...	...	...	...
NATIONAL COMPANY FOR THE DISTRIBUTION OF ELECTRICITY BY SECONDARY GENERATORS, LIMITED, 2, Warwick-st, W. (11 May, 1883.)	Wm. D'Oyly (*Chn.*), J. D. Gibbs, Sir J. D. Mackenzie, Bt., Lieut.-Gen. J. W. D'Oyly. *Secretary*, J. E. Pickering.	£470,000 in £10 ord. £30,000 in 10% pref.	£200,000 £26,690	...	...	...	...
NATIONAL TELEPHONE COMPANY, LIMITED, Oxford-court, Cannon-street, E.C. (10 March, 1881.)	James Staats Forbes (*Pres.*), Lord Balfour of Burleigh (*Vice-Pres.*), C. S. Agnew, G. Franklin, E. Heyworth, Col. R. R. Jackson, W. C. Quilter, M.P., G. H. Robertson, Sir A. K. Rollit, M.P., S. H. Sands, W. A. Smith, J. Thompson. *Gen. Man.*, W. E. L. Gaine. *Secretary*, Albert Anns.	£2,450,000 in £5 ord. £150,000 in 6% 1st pref. £150,000 in 6% 2nd pref. £1,250,000 in 5% 3rd pref. £1,000,000 in 4½% debs.	£2,422,985 £150,000 £150,000 £396,170 £1,000,000	July & Dec. July & Dec. July & Dec. July & Dec. Jan. & July	5% ('92-'93) 6% ('92-'93) 6% ('92-'93) 5% ('92-'93) ...	4¾-5 14-15 13¾-14¼ 4¼-4½ 112-14	4⅝-4⅞ 14-15 13-14 5⅛-5⅜ 113-115
NATIONAL ELECTRIC SUPPLY COMPANY, LIMITED, 119A, Fishergate, Preston. (25 Oct., 1889.)	E. H. Booth (*Chn.*), J. Muirhead, H. Curwen, T. Booth. *Man.*, J. H. Tonge. *Secretary*, T. Cross.	£99,500 in £5 ord. £500 in £5 founders'	£53,025 £500	...	...	...	...
NEW AUSTRALIAN ELECTRIC COMPANY, LIMITED, Finks-buildings, Melbourne, Victoria.	Prof. W. C. Kernot, M.A. (*Chn.*), Hon. J. F. Levien, W. Brookes, R. C. Anderson, W. N. Kernot. *Man.*, Major R. E. Joseph. *Secretary*, H. Askworth.	£250,000	£26,314	...	...	...	...
NEW BRITISH ELECTRICAL INSTALLATION CONTRACTORS, LIMITED, Broad-street, Worcester. (29 Oct., 1892.)	.....	£25,000 in £5 shares.	.....	...	...	...	...
NEW ELECTRICITY SUPPLY COMPANY OF CROYDON, LIMITED, 1, High-street, Croydon. (16 Sept., 1892.)	*Consulting Engineer*, W. F. Taylor. *Secretary (pro tem.)*, J. W. Blythe Unwin.	£39,500 in £5 ord. £500 in £5 founders'	.....	...	...	...	...
NEW TELEPHONE COMPANY, LIMITED, 58 and 59, London-wall, E.C. (20 Nov., 1884.)	J. S. Forbes, E. Heyworth, Col. R. R. Jackson, C. T. Praed, S. H. Sands, R. W. Wallace. *Gen. Man.*, A. R. Bennett. *Sec.*, W. C. Gould.	£750,000 in £10 ord. £3,000 in £1 founders'	£307,800 £3,000	...	...	4¾-5	...

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NEW ZEALAND ELECTRICAL SYNDICATE, LIMITED, Battersea Foundry, S.W. (20 Dec., 1890.)	*Chairman*, Daniel de Castro.	£30,000 in £10 shares	£29,550	...	...	...	...
NEWCASTLE AND DISTRICT ELECTRIC LIGHTING COMPANY, LIMITED, 38, Grainger-street West, Newcastle-upon-Tyne. (14 Jan., 1889.)	John D. Milburn (*Chn.*), Sir B. C. Browne Col. W. M. Angus, J. B. Simpson, Hon. C. A. Parsons (*Man.*). *Secretary*, James Patterson.	£50,000 in £10 shares	£38,000	Jan. & July	5½% ('92)	...	...
NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY COMPANY, LIMITED, Pandon Dene, Newcastle-upon-Tyne. (8 Jan., 1889.)	T. G. Gibson, J.P. (*Chn.*), J. T. Merz, Ph.D., R. S. Watson, LL.D., Col. F. Sheppee, Jas. Tennant, J. H. Armstrong, R. C. Jackson (*Man.*) *Secretary*, M. Short.	£50,000 in £5 shares	£25,984	Jan. & July	2% (int.)	...	...
NONPAREIL ELECTRIC SYNDICATE, LIMITED, 2, Victoria-mansions, Victoria-street, S.W. (13 Aug., 1890.)	.....	£6,000 in £10 shares	£4,000	...	...	...	...
NORTHAMPTON ELECTRIC LIGHT AND POWER COMPANY, LIMITED, 2, St. Giles's-square, Northampton. (5 April, 1889.)	*Secretary*, Montague Browne.	£49,990 in £1 B ord. and pref.	£12,875	...	...	...	...
		£10 in £1 A shares	£10 ...	...	...	...	...
NORTH-EASTERN TELEPHONE COMPANY, LIMITED. (20 June, 1893.)	.....	£1,000 in £1 shares	.....	...	...	...	...
NORTHERN ELECTRIC WIRE AND CABLE MANUFACTURING COMPANY, LIMITED, Lea Telegraph Works, Hackney Wick, N.E. (25 June, 1889.)	.....	£16,700 in £5 ord. £3,300 in £5 vendors'	£5,417 10s. £3,300	...	...	...	...
NORTHERN HOUSE-TO-HOUSE ELECTRICITY COMPANY, LIMITED, 21, Grainger-street West, Newcastle-on-Tyne. (26 June, 1889.)	*Secretary*, C. Harrison Stanton.	£99,500 in £5 ord. £500 in £5 founders'	..... £500	...	...	...	...
NORTH METROPOLITAN TRAMWAYS COMPANY, LIMITED, 101, Finsbury-pavement, London, E.C. (1869.)	G. Richardson (*Chn.*), J. Goddard, junr., (*Deputy Chn.*), B. Broughton, J. W. Greig, E. Hawkins. *Gen. Man.*, R. L. Adamson. *Secretary*, A. Godfrey.	£1,022,000 in £10 shrs. £87,220 in new £10 shares. £132,780 4½% pref. £310,500 debs. at 3½ to 4 %	£1,109,230 £87,220 Not allotted. £263,200	Feb., Aug.	8% 7½%	...	...
NORWICH ELECTRICITY COMPANY, LIMITED, Queen-street, Norwich. (25 Jan., 1890.)	F. W. Harmer (*Chn.*), G. F. Buxton, J. P. Coaks, A. R. Chamberlain, R. J. Colman, C. R. Gilman. *Eng. and Man.*, F. M. Long. *Secretary*, A. J. Clark.	£50,000 in £10 shares	£17,740	...	...	...	...
NOTTINGHAM ELECTRIC LIGHT AND POWER COMPANY, LIMITED—*in liquidation.*							
NOTTING HILL ELECTRIC LIGHTING COMPANY, LIMITED, Bulmer-place, Notting Hill Gate, W. (21 Feb., 1888.)	William Crookes, F.R.S. (*Chn.*), A. E. Franklin, Alexander Howden, James T. Jarvis, Francis Radford, and Sidney Waters. *Secretary*, F. G. Rawkins.	£64,520 in £10 ord. £29,980 in 6% pref. £5,500 in £10 founders'	£64,520 in ord. £8,160 £5,500	...	...	5-6	...
OGMORE VALLEY ELECTRIC LIGHT AND POWER SUPPLY COMPANY, LIMITED, 2, Wyndham-villas, Nantymoel, Bridgend, Glamorgan. (10 June, 1891.)	J. Williams (*Chn.*), W. Llewellyn, D. Sims Rees, D. Evans, D. J. Thomas, G. Williams, R. A. Williams, D. H. Evans, D. Roberts, R. G. Pugh, G. M. Griffiths. *Sec.*, George Adams.	£10,000 in £5 shares	£2,416	...	...	...	...

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USEFUL INFORMATION RELATING TO ELECTRICAL LIMITED LIABILITY CONCERNS.—*Continued.*

Name of Company, Address of Office, and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called for.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892.	Closing Quotation. 1893.
OKONITE COMPANY, LIMITED, 38, Finsbury-pavement, E.C. (24 June, 1890.)	*Trustees* for deb. holders' property in U. K.: Samuel Pope, Q.C., A. Vaughan-Stevens.	£170,000 in £10 ord. £170,000 in £10 pref. £100,000 in 6% debs.	£170,000 £170,000 £85,000	... Dec. & June	...	2½-3½ 6-7	... ...
OMNIBUS AND TRAMCAR ELECTRIC LIGHTING COMPANY, LIMITED. (28 Sept., 1893.)	.....	£60,000 in £5 shares	.....	...	...	...	...
ORIENT ELECTRIC LIGHTING COMPANY, LIMITED, 2, East India-avenue, E.C. (29 Nov., 1887.)	*Secretary*, Charles Baker.	£5,000 in £250 shares	£1,300	..	...	...	...
ORIENTAL ASSOCIATION, LIMITED, 16 and 17, Cavendish-street, W. (25 Nov., 1889.)	.....	£5,000 in £1 shares	.....	...	..	...	...
ORIENTAL TELEPHONE AND ELECTRIC COMPANY, LIMITED, 14, Austin Friars, E.C. (4 Feb., 1881.)	W. Addison (*Chn.*), B. St. John Ackers, Henry Grëwing, T. Lloyd, G. B. Frost. *Secretary*, A. B. Chalmers.	£75,000 in £1 vendors' £225,000 in £1 ord.	£75,000 £124,746	... Yearly	2½ 2¼	... $\frac{3}{16}$-$\frac{5}{16}$	... ¼
ORME'S ELECTRIC SIGNAL SYNDICATE, LIMITED, 65, Barbican, E.C. (15 June, 1893.)	Col. Howard, J. M. Grimshaw, S. Jennings, J. Orme. *Secretary*, E. J. Andrews.	£7,500 in £1 shares	.. ...	...	...	...	...
OSWESTRY ELECTRIC LIGHTING AND POWER CO., LTD., Oswald-rd, Oswestry. (2 March, 1893.)	.....	£10,000 in £1 shares	.....	...	...	...	...
OXFORD ELECTRIC COMPANY, LIMITED, 45, Broad-street, Oxford. (24 Aug., 1891.)	Sir Henry Mance, C.I.E., (*Chn.*), J. Irving Courtenay, Ald. Buckell, L. A. Selby Bigge, Emile Garcke. *Secretary*, H. Eeles.	£100,000 in £5 shares	£58,027	...	...	...	...
PACIFIC AND EUROPEAN TELEGRAPH COMPANY, LIMITED, Winchester House, Old Broad-street, E.C. (24 June, 1892.)	Sir John Pender, G.C.M.G., M.P. (*Chn.*), Lord Sackville A. Cecil, Thomas Fuller, Frederick Walters, Major Alexander Wood. *Secretary*, W. H. Axworthy.	£100,000 in £10 shares £100,000 in 4% debs.	£30,000 £100,000	.. ...	... ...	.. ...	... 102-5
PACIFIC TELEGRAPH COMPANY, LIMITED, 32, Victoria-street, S.W.	.....	£2,000,000 in £10 shares	£180	..	...	..	..
PERU TELEPHONE COMPANY, LIMITED, 42, Old Broad-st., London, E.C. (4 July, 1889.)	*Acting Secretary*, Edmund Petley.	£100,000 in £5 shares	.....	...	...	..	..
PHONOFORE COMPANY, LIMITED, Faraday House, Charing Cross-road, W.C.	Rt. Hon. Sir M. E. Grant-Duff, Bt. (*Chn.*), H. Grierson, H. Seebohm, E. F. Webster, A. Rust, General J. Shaw Stewart, A. B. Isaac, M. F. Browne, C. E. Spagnoletti (*Man. Dir.*). *Secretary*, C. Isaac.	£100,000 in £1 ord. £50,000 in £1 pref.	£90,000 £28,063	...	...	...	...
PHOSPHOR BRONZE COMPANY, LIMITED, 87, Sumner-street, Southwark, S.E. (20 May, 1874.)	James Rock (*Chn.*), Henry Seebohm (*Dep. Chn.*), Richard Gamble, Charles E. Taunton, Lazare Weiller. *Gen. Man. and Secretary*, Richard Lagerwall.	£75,000 in £5 ord. £75,000 in £5 pref. £5,000 in 6 % debs.	£36,675 £41,875	March March Jan. & Oct.	1¼% 5% 6%	... ...	... .
PIONEER ELECTRIC CARRIAGE COMPANY, LTD. (8 June, 1893.)	.....	£20,000 in £50 shares	£360	...	...	...	...
PLANET ELECTRICAL ENGINEERING CO., LTD., 28, Victoria-st., S.W. (26 March, 1889.)	*Secretary*, Claud Scott.	£30,000 in £5 shares	£16,910	...	...	...	...

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PONTYPOOL ELECTRIC LIGHT AND POWER COMPANY, LIMITED, Club-chambers, Pontypool. (28 March, 1892.)	W. Pegler, jun., E. B. Ford, W. Sandbrook, J. Herbert, J. C. Howell. *Secretary*, A. W. Watkins.	£10,000 in £5 shares	.....	...	...	...	...
PONTYPRIDD ELECTRIC LIGHTING CO., LTD., 40, Mill-st., Pontypridd. (30 April, 1889.)	.....	£10,000 in £5 shares	.....	...	...	...	...
POOLE AND WHITE, LTD, 59, Broad-street, E.C.	*—in liquidation.*						
PORTLAND ELECTRIC LIGHT COMPANY, LIMITED, 48, Osnaburgh-street, N.W. (30 Nov., 1887.)	.....	£45,000 in £5 shares	£35	...	...	...	...
POWDITCH (J. R.) AND CO., LIMITED	*—in liquidation.*						
PRINTING TELEGRAPH AND CONSTRUCTION COMPANY OF THE AGENCE HAVAS, LIMITED, 11 and 12, King William-street, E.C. (12 Jan., 1893.)	Count Max Hollender (*Chn.*), H. Houssaye (*Man.*), E. Crenietti, Col. W. J. Engledue, A. C. Ives, D. Monnier. *Secretary*, T. J. Ford.	£115,000 in £5 shares	£12,340	...	...	...	...
PYKE, HARRIS, AND CO., LIMITED 34, New Tothill-street, S.W. (10 Jan., 1893.)	L. Pyke, E. S. Harris, and E. Prentice.	£7,000 in £5 A shares £23,000 in £5 B shares	£6,090 £23,000	...	...	...	...
QUEEN ANNE'S MANSIONS LIGHTING AND HEATING COMPANY, LIMITED, 251, Winchester House, E.C. (25 June, 1891.)	H. R. Savory (*Chn.*), F. W. Reynolds, W. R. Renshaw (*Man. Dir.*) *Secretary*, J. A. Kelman.	£30,000 in £10 ord. £30,000 in £10 4½ % cum. pref. £60,000 in 6 % 1st mort. debs.	£30,000 £30,000 £43,000	Jan. & July	4½ ... 6%	... ...	... ...
RAILWAY AUTOMATIC ELECTRIC LIGHT SYNDICATE, LIMITED, 37, Walbrook, E.C. (26 Feb., 1889.)	G. J. Banks, J. Cecil Bull, Dixon H. Davies, Gen. A. E. Warren. *Man.*, John M. Tourtel.	£10,000 in £25 ord. £15,000 in £25 pref.	.....	...	...	...	...
RAILWAY ELECTRICAL FOG SIGNAL SYNDICATE, LIMITED, St. Peter's Church-walk, Nottingham. (12 May, 1891.)	.....	£25,000 in £1 shares	£18,000	...	...	...	...
RAMSDEN, CAMM AND CO., LIMITED, Brighouse, Yorks. (Oct., 1893.)	Isaac Lancaster, W. H. Shepherd, J. Hey, Hophni Bland.	£50,000 in £10 shares	.....	...	...	...	...
READING ELECTRIC SUPPLY COMPANY, LIMITED, Blagrave-street, Reading.	.....	£75,000 in £5 shares	£7	...	...	...	...
REUTER'S TELEGRAM COMPANY, LIMITED, 24, and 25, Old Jewry, E.C. (1865.)	Adm. Rt. Hon. Sir J. C. D. Hay, Bt., K.C.B. (*Chn.*), Baron de Reuter, Hon. M. F. Napier, M.P., Baron George de Reuter, F. J. Griffiths, H. de Reuter (*Man.*) *Sec.*, W. F. Bradshaw.	£100,000 in £8 shares	£94,712	June & Oct.	2½%	7½-8½	...
RICHMOND (SURREY) ELECTRIC LIGHT AND POWER COMPANY, LIMITED, 4, Sun-court, Cornhill, E.C. (8 July, 1892.)	Sir F. B. Alston, K.C.M.G. (*Chn.*), F. H. Graves Wilkinson, F. L. Muirhead, and the Chevalier Soares. *Secretary*, H. E. McLeod.	£50,000 in £5 shares	£12,180	...	...	...	...
RIVER PLATE ELECTRICITY SUPPLY COMPANY, LIMITED, 78, Coleman-street, E.C. (7 Feb., 1889.)	J. H. Duncan (*Chn.*), Thos. Farrell, Chas. Günther, E. J. Halsey, Francis Ince, W. R. Cassels (*Man.*) *Secretary*, T. S. Hamilton.	£499,000 in £10 ord. £1,000 in £1 founders'	£135,570 £892	...	..	...	...
RIVER PLATE TELEGRAPH COMPANY, LIMITED, 188, St. Vincent-street, Glasgow.	*Secretary*, J. Mann.	*No further particulars to be obtained.*		..	...	...	...

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USEFUL INFORMATION RELATING TO ELECTRICAL LIMITED LIABILITY CONCERNS.—*Continued.*

Name of Company, Address of Office, and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called up.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892.	Closing Quotation. 1893.
RUGBY SCHOOL ELECTRIC LIGHTING COMPANY, LIMITED. (24 July, 1893.)	.....	£5,500 in £50 shares	.....	...	...	...	...
ST. JAMES' AND PALL MALL ELECTRIC LIGHT COMPANY, LIMITED, Carnaby-street, Golden-square, W. (2 Mar., 1888.)	Eustace J. A. Balfour (*Chn.*), H. Woodburn Kirby (*Vice*), L. Clark, F.R.S., Sir J. H. Morris, K.C.S.I., G. W. Balfour, M.P. *Secretary and Gen. Man.*, F. J. Walker.	£99,900 in £5 ord. £100,000 in 7 % pref. £100 in £1 founders'	£99,000 £100,000 £100	Jan. & July	4½ ('93) ... 63/- ('92)	7⅜-8½ 8½-8⅝ ...	5½-6 7⅞-8⅛ ...
SALT LAKE AND OGDEN GAS AND ELECTRIC LIGHT COMPANY, LIMITED. (19 June, 1893.)	.....	£300,000 in £1 shares	.....	...	...	...	...
SAX (JULIUS) & CO., LIMITED, 7, Ridgmount-st., Bedford-sq., W.C. (28 Oct., 1892.)	.....	£20,000 in £10 shares	£19,930	...	...	...	..
SAXBY & FARMER, LIMITED, Kilburn, N.W.	.....	£25,000 in £10 shares	£20,210	...	...	...	...
SCARBOROUGH ELECTRIC SUPPLY COMPANY, LIMITED, 102, Westborough, Scarborough, (17 Nov., 1892.)	Lt.-Col. R. F. Steble, J.P. (*Chn.*), G. Alderson-Smith, J.P., John Dale, J.P., John W. Woodall, Geo. L. Beeforth, J.P., John B. Simpson, Hon. C. A. Parsons, A. A. Campbell Swinton (*Man.*). *Secretary*, John Hall.	£50,000 in £10 shares	£18,400	...	...	...	...
SCOTTISH ELECTRIC SUPPLY COMPANY, LIMITED—*in liquidation.*				..	...		...
SCOTTISH HOUSE-TO-HOUSE ELECTRICITY COMPANY, LIMITED, 14, Sherborne-lane, King William-street, E.C. (26 June, 1889.)	T. Bost, J. Hannay, G. Flett, W. D. Cairney, S. Colquhoun. *Secretary*, R. B. Jarvie.	£99,500 in £5 ord. £500 in £5 founders'	£500	...	...	...	...
SHEFFIELD ELECTRIC LIGHT AND POWER COMPANY, LIMITED, Commercial-street, Sheffield. (3 May, 1892.)	G. Franklin (*Chn.*), J. Gamble, G. Senior, W. Tasker, W. S. Laycock. *Secretary and Manager*, W. Johnson	£98,000 in £7 shares	£24,000	April	5%	...	..
SHROPSHIRE ELECTRIC LIGHT AND POWER COMPANY, LIMITED, 9, The Square, Shrewsbury. (30 Jan., 1891.)	T. S. Eaton, J. A. Bratton, R. Maddox, J. A. Lea, H. Robertson.	£25,000 in £10 ord. £100 in £1 founders'	£596	...	...	...	...
SIEMENS BROTHERS AND CO., LIMITED, 12, Queen Anne's-gate, S.W. (28 Dec., 1880.)	Carl Siemens, Alex. Siemens, Arnold von Siemens, Georg W. von Siemens. *Secretary*, Alfred Sabine.	£500,000 in £100 shrs.	£425,000	...	...	...	...
SINGLE-WIRE MULTIPLE TELEPHONE SIGNAL COMPANY, LIMITED, 11, Old Broad-street, E.C.	*Secretary*, G. R. Neilson.	£5,000 in £10 shares	£2,540	...	...	...	...
SOCIÉTÉ INDUSTRIELLE DES TÉLÉPHONES, 41, Rue Caumartin, Paris.	.....	25,000,000fr.	.....	...	..	...	...
SOUTH AFRICAN LIGHTING ASSOCIATION, LIMITED, 90, Cannon-st., E.C. (27 Oct., 1888.)	D. F. Goddard (*Chn.*), A. L. Don, J. Mansergh, W. Woodall, M.P. *Sec.*, W. Cash.	£50,000 in £10 shares £10,000 in 5% mort. deb.	£32,000 £8,000	..	8% (int.)	...	...
SOUTH AMERICAN CABLE COMPANY, LIMITED, 106, Cannon-street, E.C. (4 July, 1891.)	Sir C. Tupper, Bart., G.C.M.G., C.B. (*Chn.*), Hon. H. Marsham, Sir H. C. Mance, C.I.E., J. Y. Buchanan, R. Kaye Gray. *Secretary*, E. W. Parsons.	£500,000 in £10 shares £300,000 in 5% mort. debs.	£247,070 £300,000	..	...	...	...
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SOUTHAMPTON ELECTRIC LIGHT AND POWER COMPANY, LIMITED, 23, High-street, Southampton. (14 April, 1888.)	G. T. Harper (*Chn*), J. F. Albright, J. F. Obree, W. H. Mitchell, G. J. Tilling. *Secretary*, J. T. Hamilton.	£10,000 in £5 ord. £20,000 in £5 pref.	£3,540 £250	...	...	...	..
SOUTH OF ENGLAND HOUSE-TO-HOUSE ELECTRICITY COMPANY, LIMITED, Richmond-rd., Earl's Court, S.W. (26 June, 1889.)	...	£99,500 in £5 ord. £500 in £5 founders'	..... £500	..	...	...	...
SOUTH STAFFORDSHIRE ELECTRIC LIGHTING COMPANY, LIMITED, 33, Waterloo-street, Birmingham.	.....	£100,000 in £5 shares	£695	..	...	...	...
SOUTH STAFFORDSHIRE TRAMWAYS COMPANY, Darlaston, Staffs. (Inc. 1889.)	W. J. Carruthers-Wain (*Chn.*), C. James, W. Busby. *Mon.*, A. Dickinson. *Secretary*, H. Hatchett.	£129,650 in £10 ord. £86,580 in 6% pref. £49,830 in 5% debs.	£129,650 £76,000 £34,830	... ...	... 2/6 (1890)	...	...
SOUTH-WESTERN DISTRICT AND THAMES VALLEY ELECTRICITY SUPPLY COMPANY, LTD., Battersea Foundry, S.W. (28 June, 1889.)	Daniel de Castro (*Chn.*)	£100,000 in £10 shares	.....	..	..	...	...
SPANISH NATIONAL SUBMARINE TELEGRAPH COMPANY, LIMITED, 106, Cannon-street, E.C. (12 May, 1883.)	R. Kaye Gray (*Chn.*), S.W. Silver, M. Gray. *Secretary*, W. J. Tyler.	£499,000 in £10 ord. £1,000 in £1 founders' £140,000 in debs.	£237,190 Not issued £9,300 6% £21,800 5%	... .	1½%(1892) 6% 5%	..	...
STANDARD TIME COMPANY, LIMITED, 19 and 21, Queen Victoria-street, E.C. (28 October, 1886.)	Hon. A. G. Ponsonby (*Chn.*), Gen. Alex. Fraser, C.B., Latimer Clark. *Manager and Secretary*, Edgar Ray.	£100,000 in £1 shares	£49,378	..	...	...	...
STATTER (J. G.) AND CO., LIMITED, 68, Victoria-street, S.W. (21 Dec., 1893.)	.....	.....	.....	...	...	...	...
SUBMARINE CABLES TRUST, Winchester House, E.C. (Established 1871.)	*Trustees*, K. L. M. Anderson, Viscount Monck, Sir John Pender, G.C.M.G., M.P., J. Denison Pender, Marquis of Tweeddale. *Secretary*, Hon. A. Brodrick.	£420,000 in £100 certificates	£338,100	Apr. & Oct.	...	116-120	114-119
SUNBEAM LAMP COMPANY, LIMITED, Park House, Gateshead. (13 Dec., 1887.)	.....	£25,000 in £10 shares £3,000 in 5% debs.	£21,300	...	...	...	...
SWAN UNITED ELECTRIC LIGHT COMPANY, LIMITED, 100, Victoria-street, S.W. (19 May, 1882.)	J. S. Forbes (*Chn.*), W. C. Quilter, M.P. (*Dep. Chn.*)., E. W. Batt, J. W. Swan, Major S. Flood Page. *Secretary*, H. Charles Gover.	£1,000,000 in £5 shrs. (£500,000 issued)	£375,071 10s.	May & Nov.	7% ('92-'93)	3-3½	2¼-2¾
SWINBURNE AND CO., LIMITED, Teddington, (16 February, 1893.)	James Swinburne, Harold E. S. Holt, and Bertram R. Beale (*Man. Dirs.*), and Wroth Lethbridge and Hewitt Bostock.	£23,500 in £5 ord. £1,500 in £5 def.	£5,058 £1,500	...	...	...	...
SYNDICATE OF ELECTRICAL ENGINEERS, LIMITED, 15, St. Helen's-place, E.C. (31 Dec., 1889.)	*Secretary*, P. A. Latham.	£9,500 in £5 ord. £500 in £5 founders'	£4,028 £370	...	...	..	...
TAUNTON ELECTRIC LIGHTING COMPANY, LTD., St. James's-street, Taunton.	W. H. Fowler (*Chn.*), T. H. Beale (*Vice*), H. G. Massingham (*Man. Dir.*) *Secretary*, F. C. Bostock.	£20,000 in £5 shares	£12,845	...	...	...	...
TAYLER SMITH ELECTRIC COMPANY, LIMITED, 53, South Molton-st., W. (21 July, 1891.)	.....	£3,000 in £10 ord. £3,000 in £10 6% pref.	£3,000 £2,990	...	...	...	...

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USEFUL INFORMATION RELATING TO ELECTRICAL LIMITED LIABILITY CONCERNS.—*Continued.*

Name of Company, Address of Office, and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called up.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892.	Closing Quotation. 1893.
TAYLOR AND TUCKER, ART METAL COMPANY, LIMITED, 9, Duke-street-mansions, Grosvenor-square, W. (10 May, 1889.)	.....	£5,000 in £1 ord.	£4,400	...	...	...	...
TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, LIMITED, 38, Old Broad-street, E.C. (7 April, 1864.)	G. W. Campbell, Sir R. G. W. Herbert, G.C.B., P. Rawson, James Pender, and Admiral Sir G. H. Richards, K.C.B., F.R.S., and W. Shuter (*Joint Man. Dirs.*) *Sec.*, E. Dickens.	£448,200 in £12 shrs. £150,000 in 5% debs.	£448,200 £150,000	Mar. & July Jan. & July.	10% int. 5%	45-47 103-106	36-38 105-108
TELEGRAPH MANUFACTURING COMPANY, LTD., Britannia Works, Helsby, Cheshire. (20 Nov., 1886.)	James Taylor (*Chn.*), George Crosland Taylor, Frederic Whiteley. *Elec. Eng. and Sec.*, Alfred Whalley.	£50,000 in £10 shares	£32,400	...	5% & 2½% bonus	...	...
TELEPHONE COMPANY OF EGYPT, LIMITED, 14, Austin Friars, E.C. (30 Jan., 1883.)	Gen. A. Fraser, C.B., (*Chn.*), T. Lloyd, H. Grëwing. *Secretary*, A. B. Chalmers. *Man. in Egypt*, W. N. Evans.	£80 000 in £5 pref. £20,000 in £5 def. £20,000 in 6% debs.	£60,355 £20,000 £6,500	...	6% (1892)	...	...
TELEPHONE COMPANY OF IRELAND, LIMITED—	*absorbed by the National Telephone Company, Limited.*						
TELEPHONE COMPANY OF AUSTRIA, LIMITED—	*in liquidation. Exchanges taken over by Austrian Government as from Jan. 1, 1893.*						
THEATRE ELECTRICAL AND SPECIALITIES PRODUCTION COMPANY, LIMITED—	*struck off the Register.*						
THETFORD ELECTRIC LIGHT AND POWER COMPANY, LIMITED, St. Nicholas-street, Thetford. (23 June, 1890.)	R. G. Burrell (*Chn.*), F. J. Burrell, C. Burrell, W. Jackson. *Secretary*, R. Carter.	£5,000 in £10 shares	£2,971	...	...	...	...
THOMPSON, RITCHIE & CO., LTD, 48, James-st., Buckingham Gate, S.W. (22 Feb., 1892.)	A. S. Grove, J. C. Waltham. *Secretary*, C. H. Hurst.	£3,000 in £10 ord. £2,000 in £10 5% pref.	£1,400 £2,000	...	...	...	...
THORNEBURRY MINERS' SAFETY LAMP COMPANY, LIMITED—	*in liquidation.*	£30,000 in £5 shares.	£780	...	...	...	..
UNITED ELECTRIC TRAMWAYS COMPANY, LIMITED, 37, Queen Victoria-street, E.C. (22 Oct., 1892.)							
UNITED RIVER PLATE TELEPHONE COMPANY, LIMITED, Dashwood House, E.C. (17 Dec., 1886.)	J. Irving Courtenay (*Chn.*), F. W. Jones (*Man.*), G. Cooper, F. Green, A. Le Rossignol, and Messrs. Falls and Krable, *Cons. Dirs. Sec.*, R. Herring.	£500,000 in £5 ord. £200,000 in 7% debs. and 5% deb. stock	£290,000 £3,000 £146,370	Jan. & July Jan. & July Jan. & July	3% (1890) 7% 5%	2¾-3¼ ... 90-100	2-2½ ... 90-100
UNIVERSAL ARC LAMP SYNDICATE, LIMITED, 4, Arthur-street, New Oxford-street, W.C. (16 July, 1892.)	Charles H. Freedman, F. W. Suter, Arthur R. Carter, Harrington Wyman, A. H. Vesey. *Secretary*, T. H. Robinson.	£3,000 in £1 shares	£228. 15s.	...	...	...	...
UNIVERSAL ELECTRIC LIGHTING COMPANY, LIMITED. (7 Dec., 1893.)	.....	£5,000 in 10s. shares	.....	...	...	...	...
VEALE AND CO., LIMITED, Menacuddle-street, St. Austell. (26 May, 1892.)	.....	£10,000 in £1 shares	£9,548	...	...	...	...
VENEZUELA TELEPHONE AND ELECTRICAL APPLIANCES COMPANY, LIMITED, 37, Lombard-street, E.C. (22 April, 1890.)	Sir D. Fox (*Chn.*), J. S. Austen, J. W. Phillips, M.P. *Secretary*, J. Simpson.	£70,000 in £1 shares £70,000 in 5% 1st mortgage debs.	£70,000 £70,000	Jan. & July ...	nil. 5%	...	...

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Walsall Electrical Company, Limited, 16, Bridge-street, Walsall. (6 Dec., 1892.)	*Man. Dir.*, Frederick Brown.	£10,000 in £10 shares.	£6,830	...	...	...	...
Ward Electric Car Company, Limited—*No information obtainable.*							
Waterhouse Electrical Manufacturing Company, Limited, 67, Southwark Bridge-road, S.E. (9 Jan., 1893.)	*Man. Dir.*, Reginald Bolton.	£10,000 in £10 ord. £10,000 in £10 vendors'	£2,563 £10,000	...	...	...	..
Waterhouse Electro-Metric Syndicate, Limited, 67, Southwark Bridge-road, London, S.E. (17 Aug., 1893.)	.....	£20,000 in £10 shares	.. ...	...	...	...	...
West African Telegraph Company, Limited, Winchester House, E.C. (29 Sept., 1885.)	Sir John Pender, G.C.M.G., M.P. (*Chn.*), Sir H. C. Mance, C.I.E., R. K. Gray, J. Denison Pender (*Man.*), T. Fulller. *Secretary*, John Cambrook.	£400,000 in £10 shares £300,000 in 5% debs.	£231,090 £260,900	Dec. & July Mar. & Sept.	... ...	6½-7½ 100-103	5½-6½ 99-102
West Coast of America Telegraph Co., Ltd., 120, Cannon-street, E.C. (29 Dec., 1877.)	J. Denison Pender (*Chn.*), H. Roberts, F. Walters. *Secretary*, F. L. Robinson.	£300,000 in £10 shrs. £150,000 in 8% debs.	£300,000 £150,000	Jan. & July June & Dec.	... 8%	2½-3½ 104-108	2-3 100-104
West India and Panama Telegraph Company, Limited, Dashwood House, Old Broad-street, E.C. (9 Jan., 1877.)	C. W. Earle (*Chn.*), W. Andrews, Gerald W. Balfour, M.P., G. von Chauvin, H. Holmes. *Secretary*, R. T. Brown.	£1,650,000 in £10 ord. £345,630 in £10 1st pref £100,000 in £10 2nd pref £100,000 in 5% debs.	£883,210 £345,630 £46,690 £80,000	June & Dec. May & Nov. May & Nov. ...	1%(June'93) 6% 6% 5%	1⅛-1⅜ 10-10½ 8-9 105-108	1-1½ 9¾-10¼ 8½-9½ 108-111
Western and Brazilian Telegraph Company, Limited, 19, Great Winchester-street, E.C. (29 April, 1873.)	W. S. Andrews (*Chn.*), Lord R. H. Browne, J. Coppen, C. W. Earle, D. H. Goodsall, Major Wood (*Man.*) *Secretary*, R. M. Cunningham.	£1,500,000 (£39,435 not issued) in £15 ord. £1,500,000 (£39,435 not issued) in £7.10s. pref. ord. £1,500,000 (£39,435 not issued) in £7.10s. def. ord. £500,000 in 6% debs. (£50,000 not issued)	£963,630 £248,467½ £248,467½ A £178,200 B £222,700	May & Nov. May & Nov. May & Nov. Feb. & Aug.	2% int. 4% nil. 6% 6%	7-7½ 5¾-5¾ 1¾-2 106-109	6-6½ 5¼-5¾ 1¼-1¾ 104-107
Western Counties Electric Light and Power Syndicate, Limited, Keynsham, Somerset. (26 April, 1892.)	H. A. Hood Daniel, A. R. Wansbrough, F. Bligh Hood, G. Parfitt (*Man. Dir.*)	£19,000 in £50 ord. £6,000 in £50 def.	£4,250 £6,000	...	...	..	...
Western House-to-House Electricity Company, Limited, 13, John-street, Bristol. (26 June, 1889.)	.....	£99,500 in £5 ord. £500 in £5 founders'	..... £500	...	...	..	...
Western Union Telegraph Company, Limited, New York; and 252, Gresham House, London, E.C. (Inc. 1855.)	*Pres. and Gen. Man.*, Thos. T. Eckert. *Representative in England*, G. von Chauvin.	$100,000,000 in $100 capital stock. $1,500,000 in 7% 1st mortgage debs. $4,920,000 in 7% curr. bonds. £1,030,000 in 6% ster. bonds.	$86,200,000 $1,219,000 $4,920,000 £169,100	Jan., April, July, & Oct. May & Nov. May & Nov. Mar. & Sept.	1¼% quarterly 7% 7% 6%	... 120-125 100-103	... 113 118 102-105
Westinghouse Electric Company, Limited, 32, Victoria-street, S.W. (11 July, 1889.)	George Westinghouse, jun. (*Pres.*), Francis Pavy (*Vice-Pres. and Chn.*), J. Dixon Gibbs, Sir Henry W. Tyler. *Secretary*, Arthur E. Scanes.	$8,181,000 in 6% bonds. £300,000 in £10 ord. £300,000 in £10 pref.	$8,181,000 £200,000 £177,010	...	...	...	...

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Name of Company, Address of Office, and Date of Registration.	Directors and Chief Officials.	Nominal or Authorised Capital.	Total Amount called up.	Dividends Payable.	Last Dividend Paid.	Closing Quotation. 1892.	Closing Quotation. 1893.
WESTMINSTER ELECTRIC SUPPLY CORPORATION, LIMITED, Eccleston-place, Belgravia, S.W. (30 June, 1888.)	Lord Suffield, K.C.B. (*Chn.*), E. Boulnois, M.P., J. Browne Martin, W. Hayes Fisher, M.P., Sir D. Galton, K.C.B., F.R.S., James Heslop Powell, R. W. Wallace. *Gen. Man.*, Capt. E. I. Bax. *Sec.*, F. Iago, F.I.S.	£299,500 in £5 ord. £500 in £5 founders' 5% debs. 4½% debs.	£299,500 £500 £29,400 £70,600	...	3½%	5½-6	5-5½
WEYBRIDGE ELECTRIC SUPPLY COMPANY, LTD., Thames-street, Weybridge.	*Superintendent*, Harvey C. Buchanan.	£15,000 in £5 shares	£7,435	...	...	..	...
WEYMERSCH ELECTRIC BATTERY SYNDICATE, LIMITED, 2, Victoria Mansions, Victoria-street, S.W. (28 Nov., 1890.)	*Secretary*, C. F. Jones.	£20,000 in £5 shares	£4,300	...	...	...	...
WILLANS AND ROBINSON, LIMITED, Ferry Works, Thames Ditton. (12 Jan., 1888.)	.....	£200,000 in £50 shares	£62,265	...	...	...	...
WILLIAMSON ELECTRICAL AND ENGINEERING	COMPANY—*in liquidation.*	.....	.....	...	...	...	...
WINDSOR AND ETON ELECTRIC LIGHT COMPANY,	LIMITED—*in liquidation.*						
WOKING ELECTRIC SUPPLY COMPANY, LIMITED, School Board-road, Woking. (30 May, 1889.)	*Secretary*, E. Mann.	£20,000 in £5 shares	£14,500	...	...	...	...
WOLVERHAMPTON ELECTRIC LIGHT AND POWER COMPANY, LIMITED, 80, Lichfield-street, Wolverhampton. (18 June, 1889.)	.. ...	£50,000 in £10 shares	£230	...	...	...	...
WOODHOUSE AND RAWSON UNITED, LIMITED, 88, Queen Victoria-street, E.C. (12 July, 1889.)	*Receiver and Manager*, C. Leslie.	£300,000 in £5 ord. £250,000 in £5 pref. £100,000 in 6% 1st mortgage debs. £100,000, in 5½% stock.	£229,092 10s. £205,340 £65,500 £118,187	... .. 	nil. nil. 	... ... 	... ...
WOOLWICH DISTRICT ELECTRIC LIGHT COMPANY, LIMITED, 39, William-street, Woolwich. (June, 1889.)	J. R. Jolly, J.P. (*Chn.*). *Secretary*, J. A. Findlay.	£10,000 in £1 shares	£1,533	...	...	...	...
WREXHAM AND DISTRICT ELECTRIC LIGHT SUPPLY COMPANY, LIMITED, 12, Queen-street, Wrexham, (19 Dec., 1889.)	W. Lester (*Chn.*), F. W. Soames, R. H. Done, S. T. Reeves. *Secretary*, Bernard Lewis.	£20,000 in £5 shares	... ..	...	...	...	...
WYNDHAM ELECTRIC LIGHT COMPANY, LTD., Old Bank-chambers, Market-square, Pontypridd. (6 July, 1891.)	. ....	£1,500 in £1 shares	£885	...	...	...	...
WYNNE'S ELECTRIC CLOSED TUBE TRAMWAYS, LTD., 5, Victoria-st., S.W. (28 July, 1887.)	.....	£6,000 in £100 shares	£5,400	...	...	...	...
YORKSHIRE HOUSE-TO-HOUSE ELECTRICITY COMPANY, LIMITED, Whitehall-road, Leeds. (26 June, 1889.)	Grosvenor Talbot (*Chn.*), G. H. Crowther, R. W. Eddison, R. Hudson, S. Ingham, A. G. Lupton, J. T. Pearson (*Man.*), H. Dickinson. *Secretary*, W. T. Green.	£99,500 in £5 ord. £500 in £5 founders'	£39,109 £500	.....	...	..	...

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PRINCIPAL ELECTRIC LIGHTING PATENTS EXPIRING IN 1894, 1895 AND 1896.

Among the patents which expire, if not already dropped, during 1894, 1895 and 1896 are the following :—

EXPIRE **1894.**

Dated 1880.	No.	Name.	Subject of Patent.
Jan. 2	18	J. W. SWAN	"Running on the pump."
Jan. 20	250	J. W. SWAN	Parchmentised paper filament.
Jan. 23	315	W. R. LAKE	Thomson-Houston dynamo.
Feb. 10	578	T. A. EDISON	Lampholders
Apr. 5	1,392	W. R. LAKE	Maxim dynamo.
Apr. 6	1,397	C. D. ABEL	Pilsen lamp.
Sept. 16	3,765	E. C. BREWER	Edison's bamboo filament.
Sept. 24	3,880	P. JENSEN	Edison's feeder system.
Nov. 27	4,933	J. W. SWAN	Parchmentised cotton filament.

EXPIRE **1895.**

Dated 1881.	No.	Name.	Subject of Patent.
Jan. 11	129	C. FAURE	Secondary lead battery, pasted plate.
Feb. 23	768	T. A. EDISON	Lamp filament joint, by plating.
Feb. 28	783	J. PERRY & W. E. AYRTON	Electric traction, buried conductor and block system.
Apr. 26	1,802	T. A. EDISON	Screw lamp holder and lead fuse.
Apr. 28	1,835	C. F. BRUSH	The Brush regulator.
May 10	2,038	R. J. GÜLCHER	The Gülcher arc lamp.
July 7	2,989	J. HOPKINSON	Coupling two or more motors, in series or parallel, for varying the speed of vehicles.
July 21	3,189	H. S. MAXIM	The Maxim glow lamp.
Aug. 18	3,599	C. LEVER	The Lever arc lamp.
Sept. 10	3,926	J. S. SELLON	Secondary battery plates, roughened and indented.
Sept. 29	4,202	J. W. SWAN	Lamp filament jointing by flashing.
Oct. 11	4,409	W. O. CALLENDER	Vulcanized bitumen for cables.
Dec. 28	5,702	J. W. SWAN	Lamp holder for bottom-loop lamps.

EXPIRE UP TO JUNE, **1896.**

Dated 1882.	No.	Name.	Subject of Patent.
Jan. 4	49	J. HOPKINSON	Motor meter.
Feb. 15	730	C. A. FAURE	Mercury motor meter.
Mar. 7	1,094	E. H. JOHNSON	Edison socket lampholder.
Mar. 23	1,412	WOODHOUSE AND RAWSON	Half-silvered glow lamp.
June 5	2,642	W. E. AYRTON & J. PERRY	Pendulum meter.

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THE FOWLER-WARING CABLES COMPANY, LIMITED,

VICTORIA MANSIONS, 32, VICTORIA STREET, LONDON, S.W.,

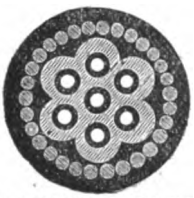
Manufacturers of all classes of VULCANISED & PURE INDIA-RUBBER WIRES & CABLES.

SOLE MANUFACTURERS OF

LEAD-COVERED CABLES

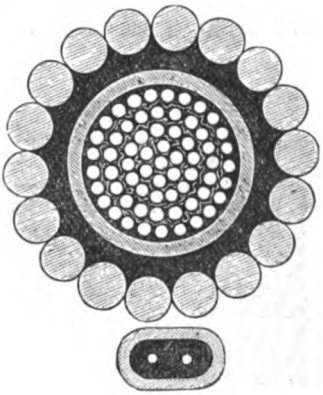
Under the Co.'s Patents for TELEPHONE, TELEGRAPH, ELECTRIC LIGHT, TRANSMISSION of POWER, and UNDERGROUND INSTALLATIONS of EVERY KIND.

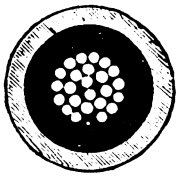
SPECIAL ANTI-INDUCTION TELEPHONE CABLES.



UNAFFECTED BY HEAT.
MECHANICAL STRENGTH.
HIGH INSULATION.
LOW CAPACITY.

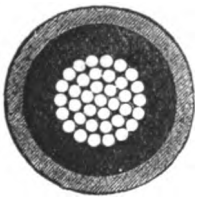
GOLD MEDAL PARIS EXHIBITION.

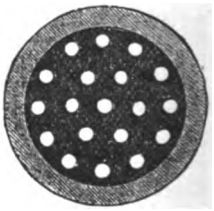




STEAMSHIPS. DOCKS.
CHEMICAL WORKS.
FACTORIES. MINES.
DAMP PLACES, &c.

References and particulars on application.





Works:

NORTH WOOLWICH, E.

Telephones { WORKS, 5091. OFFICES, 3180.

CROMPTON & CO., Ltd.

CONTRACT FOR THE

COMPLETE EQUIPMENT

OF

CENTRAL STATIONS.

The following are a few examples of Installations completely carried out by CROMPTON and CO., Limited, or where their machinery is erected:—

Kensington and Knightsbridge Electric Lighting Company.
Liverpool Electric Lighting Company.
Notting Hill Electric Lighting Company.
Chelmsford Electric Lighting Company.
Westminster Electric Lighting Company.
Northampton Electric Lighting Company.
Hove Electric Lighting Company.
Southampton Electric Light and Power Company.
Hull Corporation.
Great Eastern Railway, Liverpool Street, E.C.
Gothenburg Electric Lighting Company.
Vienna Court Opera and Lighting Company.
Pretoria, South Africa.
Le Mans Electric Lighting Company, &c., &c.

Reports and Estimates on Application.

CROMPTON & CO., Ld., Electrical Engineers and Contractors, } **Mansion House Buildings, LONDON, E.C.**

SHOW ROOMS FOR DOMESTIC APPLIANCES: 148, BROMPTON RD., S.W.

WORKS: LONDON (1, Lillie Rd., W. Brompton) & CHELMSFORD.

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ADDENDA AND ERRATA.

ADDITIONAL NAMES AND ADDRESSES, &c.

Austen, A., Electrical Apparatus Maker, 54, Olivia-st, Liverpool

Bathurst, Frederick, Electrician, 111, King Henry's-rd., South Hampstead, London, N.W.

Chesters (T.) & Sons, Limited, Electrical Engineers, Bootle.

Easton, Anderson & Goolden, Limited, Electrical and General Engineers, 3, Whitehall-place, London, S.W. (Registered on Jan. 26, 1894, with a capital of £200,000.)

Edwards, G. & R., Electrical Engineers, 13, South-st, Camberwell, and 13, St. George's-st, Commercial-rd, Peckham, London, S.E.

Incandescent Electric Lamp Company, Limited, Brook Green Works, Hammersmith, W., and (City Offices) 31, Copthall-avenue, E.C., London

Manufacturers only of every description of high-class Incandescent Lamps.

Marine Steam Turbine Company, Limited, Heaton Works, Newcastle-upon-Tyne. (Registered on Jan. 23, 1894, with a capital of £25,000.)

Martin, C. P., Representative of Messrs. C. A. Parsons & Co, 66, Victoria-st, London, S.W.

Maxwell Brothers, Limited, Electric Light Contractors, 185, Upper Thames-st, London, E.C.

Mildé Telephones and Electric Supply Company, Limited, 60, Watling-st, London, E.C. (William Saurin, Secretary.) (Registered on Jan. 29, 1894, with a capital of £20,000.)

Mundy, George, Practical Electrician, 41 and 41A, Hawley-crescent, Camden Town, London, N.W.

Smith, Geo. W., Electric Bell Fitter, 15, Middle-st, Brighton

Spencer, —, Electrical Apparatus Maker, 37, Hampstead-rd, London, N.W.

Tongue, J. E., Consulting Electrical Engineer, St. Stephen's-chmbrs, Bristol

BIOGRAPHICAL DIVISION.

ESSON, W. B. (p. xxviii.)—In February, 1894, Mr. Esson left the Gülcher Company to become Manager of the Electric Light, Electric Transmission of Power and Electro-Chemical Departments of Messrs. Johnson and Phillips, at Charlton, Kent

HERTZ, Dr. Heinrich (p.xliv.)—The sketch of Dr. Hertz's career has been retained in this Division, the regretted death of this eminent scientist having occurred on New Year's Day, 1894.

[P.T.O.

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THE FOLLOWING CORRECTIONS ARE NECESSARY.

P. 106.—In line 29, *for* "*un*frequent" *read* "frequent"
Pp. 282 and 343.—Electric Arms and Ammunition Syndicate, Limited: This Company is now in voluntary liquidation
Pp. 289 and 329.—Messrs. Latimer Clark, Muirhead & Co., Limited: This Company is now in voluntary liquidation
P. 289.—Laing, Wharton and Down Construction Syndicate, Limited:—The share capital should be given as £100,000 in £10 ord. shares, of which £40,337 10s. has been paid up, and in respect of which the last dividend paid was 5 per cent. The item, £25,000 in loans, should be omitted
P. 293.—The entry relating to the Northern Electric Wire and Cable Company, Limited, should be omitted
P. 298.—Telegraph Construction and Maintenance Company, Limited:—Adm. Sir G. H. Richards, K.C.B., F.R.S., is Chairman, *vice* Sir George Elliot, Bart.; and Mr. W. Shuter is sole Managing Director
P. 317.—Messrs. R. Bolton & Co, Limited: This Company is being compulsorily wound up
P. 323.—The telegraphic address of Mr. J. Burns, 15, Long-lane, London, E.C., is *Isolateur London*
Pp. 328 and 460.—*For* City and Guilds Central Institution, *read* City and Guilds Central Technical College
P. 338.—The telegraphic address of the Delaware Hard Fibre Company is *Isolateur London*
P. 338.—Mr. J. Devonshire is Manager and Secretary of the Laing, Wharton and Down Construction Syndicate, Limited
P. 343.—Electric Exploitation Company, Limited: Mr. V. C. Doubleday is Managing Director, and the telegraphic address is *Safetybeams London*
P. 344.—Electrical Trades' Union: The offices are removed from Chancery-lane to the Club Union Hall, Clerkenwell-road, London, E.C.
P. 345.—Eley, Harris H.: *for* 88, Colston-st, &c., *read* Kelvin Lodge, Upper Belmont-rd, Bristol
P. 359.—Grist (Charles J.) & Co: *for* 61, Piccadilly, Manchester, *read* 15, Brazennose-st, Manchester
P. 377.—Mr. C. J. Wharton is now Chairman of the Laing, Wharton and Down Construction Syndicate, Limited, *vice* Col. Martindale, C.B.
P. 393.—The entry relating to G. H. Nisbett *should read:* Nisbett, G. H., Chief Engineer to the British Insulated Wire Company, Limited, Prescot, Lancs. (*Insulator Prescot*)
P. 407.—Robinson, C. Norman: *for* College-hill, *read* College Green
P. 426.—Turner, Charles: *add* Engineer to the Woking Electric Supply Company, Limited

POSTAL RATES.

"THE ELECTRICIAN" ELECTRICAL TRADES' DIRECTORY AND HANDBOOK for 1894 will be promptly forwarded on receipt of **7s. 6d.**, and the following extra amounts for postage:—

	s.	d.
Great Britain and Ireland	0	9
Abroad	1	4

(In a few places a small additional charge is made on Delivery.)

(*For General Postal Information see pp. 196-200.*)

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"THE ELECTRICIAN"

ELECTRICAL TRADES' DIRECTORY.

BRITISH DIVISION.

ALPHABETICAL SECTION.

NOTES.—*Telegraphic and Cable Addresses and Telephone Numbers are shown in italics. In order to render* "THE ELECTRICIAN" ELECTRICAL TRADES' DIRECTORY AND HANDBOOK *as complete and serviceable as possible, the Editors will be glad to receive during 1894 Changes of Address, Names and Addresses not included in the present Edition, newly-registered Telegraphic and Cable Addresses and Telephone Numbers.* No charge is made for inserting these particulars.

The entries in the Alphabetical Section relating to Companies registered under the Limited Liability Acts are—as far as possible—completed in pages 274 *to* 300.

An asterisk (*) *prefixed to a name indicates that a* BIOGRAPHICAL SKETCH *appears at the end of the book.*

Advertisers *in* THE DIRECTORY *will find* **prominent reference** *made to their Advertisements, and to the pages in which they occur.*

— A —

A. & J. Stewart & Clydesdale, Limited—*see* Stewart (A. & J.) & Clydesdale

Abbott, Anderson & Abbott, India Rubber Manufacturers, 70, Watling-st, and 15, Queen-st, London, E.C. Works: Dod-st, Limehouse, E. (*Abbotts London*)

Abbott & Co., Boiler Makers, Newark-on-Trent. (*Abbott Newark*)

Abbott (John) & Co, Limited, Engineers and Ironfounders, Park Works, Gateshead-on-Tyne; and Suffolk House, Laurence Pountney Hill, London, E.C. (*Abbott Gateshead, Courteslee London*)

Abel & Imray, Patent Agents and Consulting Engineers, 28, Southampton-bldgs, London, W.C. (*Patentable London, 2729*)

*Abel, Sir Frederick, K.C.B., D.C.L., D.Sc., F.R.S., Secretary of the Imperial Institute, 40, Cadogan-pl, London, S.W.

Abell, T. Knill, Electrician, Old Market Place, St. Helens, Lancs.

Abell's Electrical Engineering Company, Ltd. —*in liquidation.* (Mr. F. W. Marsh, C.A., Liverpool and St. Helens, Lancs., Liquidator)

Abercrombie & Son, Brass Founders and Electric Bell Fitters, 32-36, Whitfield-st, London, W.

Abernethy, G. N., Consulting Engineer, 4, Delahay-st, London, S.W.

Abrahamson, M. A., Electrician, 101, Lexham-gdns, Kensington, London, W.

Accordion Pleating Manufacturing Company, Lamp Shade Makers, 17, Long-lane, E.C., and 228, Euston-rd, N.W., London.

Ackery, Henry Melville, Consulting Electrician, 18, Merrion-avenue, Blackrock, county Dublin

Acme and Immisch Electric Works, Limited, Electrical Engineers, Queen-street-chmbrs, Queen-st, E.C., and Ferdinand-st, Chalk Farm, N.W., London. (W. Bullock, Secretary)

Acme Ventilating and Heating Company, Ventilating Engineers, 35, Tarleton-st, Liverpool; and 13, King-st, Cheapside, London, E.C. (W. Walker, Secretary) (*Keyworth Liverpool, 1877*)

a'Court, Sidney, Assoc.M.Inst.C.E., A.I.E.E., Consulting Electrical Engineer, 19, Old Queen-st, Westminster, London, S.W. (*Togatus London*)

Adam (J. M.) & Co, Ventilating, Heating, and Lighting Engineers, and Manufacturers of Adam's Patent Air Pipe, Ibrox Works, Govan, Glasgow. (*Adamant Glasgow, 1693*)

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Adams, Alex. J. S., Telegraph Engineer, Postal Telegraphs, General Post Office, London, E.C.

Adams & Co, Sanitary and General Engineers Little Queen-st, Westminster, London, S.W. ; and also at York, Manchester, &c.

Adams, Henry, M.I.C.E., &c., Consulting Engineer, 60, Queen Victoria-st, London, E.C. (*Viburnum London.*)

Expert in Building Construction and Structural Ironwork.

Adams & Son, Electricians and Electric Bell Manufacturers, 57, Haymarket, London, S.W., 41 and 42, Marshall-st, W., London

*Adams, Prof. W. Grylls, D.Sc., F.R.S., Wheatstone Laboratory, King's College, W.C., and 43, Notting-hill-sq, W., London

Adams, W. P., Electrical Engineer, 2, Cambridge-villas, Roehampton, Surrey

Adams-Randall, Chas., Electrician, 1, The Avenue, Bedford Park, London, W.

Adamson (D.) & Co, High-Speed Engine Makers, Dukinfield, Manchester ; and 15, George-st, Mansion House, London, E.C. (*Adamson Dukinfield, 9*)

Adamson, D. F., A.I.E.E., Electrical Engineer, 72, Finsbury Pavement, London, E.C.

Adamson, E. W., Telegraph Engineer, Postal Telegraphs, Eastdean, Eastbourne

Addenbrooke, G. L., Consulting Electrical Engineer, 41, Charing Cross-mansions, Charing Cross-rd, London, W.C.

Addington Timber, Slate and Cement Company, Limited, Makers of Electric Light Conduits, &c., Addington-sq, Camberwell, London, S.E. (*Andako London, 4668*)

Addison, Major G. W., R.E., Superintending Engineer Postal Telegraphs, 54, Courtfield-grdns, London, S.W.

Adie, Patrick, Mathematical Instrument Maker, Broadway Works, Westminster, London, S.W.

ADMIRALTY, Whitehall, London, S.W. (*For Officials, see p. 232*)

Adshead & Smellie, Art Metal Workers, Ivanhoe Works, Oxford-st, Dudley

"Æolus" Waterspray Ventilating and Electrical Engineering Company, 22, Bath-street, Glasgow, and 11, Queen Victoria Street, London, E.C.

AFRICAN DIRECT TELEGRAPH COMPANY, Limited, Winchester House, Old Broad-st, London, E.C. (*Amulet London*)

Sir John Pender, G.C.M.G., M.P. ... ... } Chairman
Thomas Fuller ... ... Managing Director
H. E. Plank ... ... Secretary

See also page 274

African Trans-Continental Telegraph Company, Limited, 19, St. Swithin's-lane, London, E.C.

Duke of Abercorn, K.G. ... President
Hon. C. J. Rhodes ... ... Man. Director
Herbert Canning ... ... Sec. in England
Dr. F. Rutherfoord Harris... Sec. in S. Africa

See also page 274.

Aird, Joseph, Maker of Iron Telegraph and Telephone Poles and Electric Light Posts, Wellington Tube Works, Great Bridge, Tipton, Staffordshire ; and 46, Queen Victoria-st, London, E.C. (*Vigilantia Tipton ; Vigilantia London, 1772*)

Airdrie Iron Company, Engineers, Ironfounders, and Boiler Makers, Airdrie ; and 4, St. Mary Axe, London, E.C. (*Iron Airdrie*)

Aitken, W., Telephone Engineer, National Telephone Company, Limited, Royal Exchange-bldgs, Glasgow. (*679*)

Akester Electro Motor and Accumulator Company, Limited, Makers of Electric Motors, &c., 12, Ropemaker-st, London, E.C.

See also page 274.

Akester Electric Syndicate, Limited, Granville House, 3, Arundel-st, London, W.C.

Akrill (Charles) & Co, Manufacturers of Castings and Forgings, Golds Green Foundry, West Bromwich. (*Akrill West Bromwich*)

Alabaster (H.), Gatehouse & Co, Consulting Electrical Engineers, 22, Paternoster-row, London, E.C. (*Ayeckay London, 517*)

Aland & Co, Makers of Aland's Patent Ventilating Air Propellers, 46, Commercial-rd, Lambeth, London, S.E. (*Ulmine London*)

Albert Electric Lighting Company, Limited, Electricians and Mechanical Engineers, 110, Fenchurch-st, London, E.C. (William Fleck, Secretary)

See also page 274.

Albion Clay Company, Limited, Makers of Underground Pipes and Conduits, Albion Works, Woodville, Burton-on-Trent ; 18, New Bridge-st, E.C., and Midland Railway New Goods Station, Euston-rd, N., London. (*Sewerage London, 2958*)

Albion Engineering and Contract Company, Limited, Engineers and Contractors, 35A, Queen Victoria-st, London, E.C.

*Albright, J. F., Consulting Electrician, Joint Managing Director of Crompton & Co, Limited, Mansion House-bldgs, London, E.C.

Alchin A. H., Consulting Engineer, 2, Guildhall-chmbrs, Basinghall-st, London, E.C.

Alcott, Edward, Maker of Electric Wire Casings, 53A and 55, East-rd, City-rd, London, N.

Alder (H. B.) & Co, Paint Manufacturers, 60, Fenchurch-st, E.C., and Works, Church-row, Limehouse, E., London. (*Tropic London, 2288* and *5036*)

Alderton, Keen, & Co., Manufacturing Electricians, 1B, Robertson-st, Hastings (317), and London-rd, St. Leonards (59)

Aldred, William, Electrician, 5, Brightside-bank, Brightside, Sheffield

Aldridge, Frederick, Telegraph Instrument Maker, 49, Northampton-st, London, E.C.

Aldridge, J. G. W., A.M.I.C.E., Consulting Electrical Engineer, 9, Victoria-st, London, S.W., and 23, High-st, Southampton

Aldworth, J., Manager, Douglas and Laxey Coast Electric Tramway, Limited, Douglas, Isle of Man

Alexander, David, Electrical Engineer, 5, Ardgowan-ter, Glasgow

Alexander (E. P.) & Son, Chartered Patent Agents, 19, Southampton-bldgs, London, W.C. (*Epa London*)

Alexander, W. J., A.I.E.E., Electrical Engineer, 2, Manor-rd, Twickenham, London, S.W.

Alford, E. J., Electrical Apparatus Maker, 56, Clifton-st, Brighton

Alford, R, Engineer and Electrician, Newton-st, Gorton, Manchester

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Alkali Syndicate, Limited, Alkali Manufacturers, 41, North John-st, Liverpool

Allam (E. P.) & Co, Electrical Engineers, 49, Finsbury-pavement, London, E.C.

Allan (George) & Co, Aluminium Merchants, 10, Austinfriars, E.C. (*Clematis London*)

Allan, G. E., B.Sc., c/o Physical Society of Glasgow, University, Glasgow (19)

Allan (James, sen.) & Son, Makers of Electric Lamp Posts, Blackpool

Allcock Bros, Call and Alarm Bell Manufacturers, 24-28, King Edward's-rd, Birmingham

Alldays and Onions Pneumatic Engineering Company, Ironfounders, Pneumatic Engineers, &c., 13 and 14, Abchurch-lane, and 15, Sherborne-lane, London, E.C.; and Western Works, Birmingham. (*Alldays Birmingham; Typhoon London*)

Allen (A. H.) & Moor, Electricians and Electro-Chemists, 101, Leadenhall-st, London, E.C. (*Assaying London*)

Allen (C.) & Son, Electrical Engineers, Tone Engineering Works, Taunton

Allen (Edgar) & Co, Limited, Manufacturers of Steel for Permanent Magnets, Lathe Tools, Chisels, Drills, &c., Imperial Steel Works, Tinsley, Sheffield (*Allen Sheffield, 917*)

Sole Makers of the Patent IMPERIAL *Dynamo Magnet Steel Castings.*

Allen & Co, Electrical Engineers, 9, Bridge-st, Westminster, London, S.W. (*Allen Palatable London*)

Allen (F.) & Sons, Manufacturing Chemists, Phœnix Works, 164, Upper North-st, Poplar, London, E. (*Nitric London, 5047*).

Allen, Percy R., Electrician, Oncken Patent Staveless Barrel Company, Limited, 21, Godliman-st, London, E.C.

Allen & Hanbury, Electro-Chemists, Three Colts-lane, Bethnal Green Junction, E., Plough-ct, 37, Lombard-st, E.C., and 7, Vere-st, Cavendish-sq, W., London. (*Allenburys London*)

Allen & Mannooch, Electric Light Engineers and Contractors, 128, Mount-st, 11, Farm-st, and 1a, Davies-mews, Berkeley-sq, London, W.

ALLEN (W. H.) & CO, Mechanical and Electrical Engineers, York-street Works, York-rd., Lambeth, London, S.E. (*Pump London, 4038*) See Advt., p. 37.

Allen, William, Maker of Battery Jars and Insulators, Benthall Pottery, Broseley, Salop

Allen, W. J., Electrical Engineer, Building Department, Messrs. J. & J. Colman, Carron Works, Norwich

Allen (W. T.) & Co, Art Metal Workers, 132, Queen Victoria-st, London, E.C.

Alley & Maclellan, Engineers and Shipbuilders, Sentinel Works, Polmadie-rd, Glasgow; and 32, Victoria-st, London, S.W. (*Alley Glasgow*)

Allin, S. S., Electrician, 52, Woodstock-rd, Bedford Park, London, W.

Allison Bros, Patent Agents, 52, Chancery-lane, London, W.C. (*Nosilla London*)

Allison, W. B., London Agent for Messrs. King, Mendham & Co, 12, Fenchurch-st, London, E.C.

Allnutt, J. E., India Rubber Goods Manufacturer and Dealer, 12, Little Britain, London, E.C.

Allport, Charles James, Electrical Engineer, 24, Woburn-pl, Russell-sq, London, W.C.

Allpress & Co, Electrical Engineers, 55, Victoria-st, London, S.W. (*3063*)

ALLSOP (F.C.) & CO, Manufacturing Electricians, 165, Queen Victoria-st, London, E.C.

Almack, Edward, Electrician, c/o Messrs. Coates, Son & Co., 99, Gresham-st, London, E.C.

Alum, China Clay & Vitriol Company, Limited. Sulphuric Acid Manufacturers, 63, Queen Victoria-st, London, E.C.; and Rainham, Essex. (*Chinnock London*)

Aluminium Company, Limited, 13 and 14, Abchurch-lane, London, E.C. Works: Oldbury, near Birmingham. (G. H. Clarkson, Secretary.) (*Muidos London*)

Aluminium Foundry Company, Aluminium Manufacturers, 36, Percival-st, London, E.C.

Alwyn, L., Sole Agent for Private Installations in the City of London for the Brush Electrical Engineering Company, Limited, 53, Queen Victoria-st, E.C., and 15, Norfolk-st, Strand, W.C., London

Alwyn, L., Limited, Electricians (Agents for the Brush Electrical Engineering Company) Bristol.

See also page 274.

Ambridge (H.) & Sons, Scientific Instrument Case Makers, 48, Myrtle-st, Hoxton, London, N.

American Elevator Company—*now* Otis Elevator Company, Limited (*q.v.*)

Ames, J. G., Electrician, Fen House, Frome, Somerset

Amos & Smith, Electric Launch Builders, Albert Dock Works, Hull

Anchor Tube Company, Iron Tube Makers, Gas-st, Birmingham; and 110, Cannon-st, London, E.C. (*Anchor Birmingham*)

Ancoats Vale Rubber Company, Limited. India Rubber Manufacturers, 11, Bow-lane, London, E.C.; and Palmerston-st, Ancoats, Manchester. (*Macdowell London; Elastica Manchester. 415*)

Anders, Geo. L., Electrical Engineer, Telephone-bldg, 31, Queen Victoria-st, London, E.C.

ANDERS TELEPHONE COMPANY, Limited, Telephone Engineers, Telephone-bldgs, 31, Queen Victoria-st, London, E.C. (*Remeasure London*) See Advt., p. 630

*Andersen, F. V., Consulting Electrical Engineer, 14, Westdown-rd, Catford, London, S.E.

Andersen, J. M., Electrician, 2, Lancaster-pl, Strand, London, W.C.

Anderson, Alex., Electrician, and Professor of Natural Philosophy, Queen's College, Galway

Anderson, Anderson & Anderson, Limited, India Rubber and Driving Band Manufacturers, 37, Queen Victoria-st, and 35, St. Paul's-churchyard, London, E.C.; High-st, Bristol; and Queen-st, Cardiff. Works: Bow-rd, London, E. (*Rubberics London; Waterproof Bristol; Waterproof Cardiff*)

Anderson, Christopher, Electrician, Lane House, Jack-lane, Hunslet, Leeds

Anderson & Co, Electrical Engineers and Makers of the "Forward" Plating Dynamo, 36, Constitution-hill, Birmingham

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Anderson (D.) & Son, Limited, Makers of Non-Conducting Silicate Cloth for Boilers, Steam Pipes, &c., 812, Old Ford-rd, Bow, London, E.; 118, Broomielaw, Glasgow; and Lagan Felt Works, Belfast. (*Ulster London, 5412; Lewis Broomielaw Glasgow; Anderson Belfast*)

Anderson, J., Superintendent Commercial Cable Company, Dundee

Anderson, James, Scientific Instrument Maker, 10, Crawford-passage, Clerkenwell, London, E.C.

Anderson, Joseph, Electric Light Engineer and Contractor, Carnoustie, near Dundee

Anderson, Laverick & Co., Limited, Iron and Brass Founders, Mechanical and Electrical Engineers, Mushroom Slipway, St. Lawrence, Newcastle-on-Tyne

Anderson & Munro, Electrical Engineers, 136, Bothwell-st, Glasgow. Works: Moncrieff-st, Glasgow. (*Light Glasgow, 3421*)

Anderson (R.) & Co, Electrical Engineers and Lightning Conductor Manufacturers, 101, Leadenhall-st., London, E. (*Tonnere London*)

Anderson, Richard, F.C.S., Electrical Engineer, 101, Leadenhall-street, London, E.C.

Anderson, S. L., Electrician, 123, Upper Hanover-st, Sheffield

Anderson, T. Scott, A.I.E.E., Electrical Engineer, Royal Insurance-bldgs, Sheffield

Anderson, W., D.C.L., F.R.S., M.Inst.C.E., Director-General of the Royal Ordnance Factories, RoyalArsenal, Woolwich (*8417*); and Lesney House, Erith, Kent.

Anderston Foundry Company, Limited, Makers of High-Speed Engines and Manufacturers of Dynamo Castings, Glasgow; Middlesbrough; and 9, New Broad-st, London, E.C.

Anderton, —, Electrician, 171, Eyre-st, Sheffield

Andreae Bros, Electrical Engineers and Aluminium Manufacturers, 85, London-wall, London, E.C.

Andreae (Walter) & Co, Electrical Engineers 179, Victoria-st, London, S.W.

Andreoli, Emile, Electrician and Electro-Chemist, 18, Somerleyton-rd, Brixton, S.W., and Letchford-bldgs, Three Colts-lane, Bethnal Green, E., London

Andreoli, Gabriel, Electrician and Electro-chemist, 18, Somerleyton-rd, Brixton, London, S.W.

Andrew (J. E. H.) & Co, Limited, Makers of the Stockport Gas Engine, 80, Queen Victoria-st, London, E.C.; and Reddish, near Stockport, Lancashire. (*Andrew London; Andrew Reddish, 227*)

Andrew, John R., Telegraph Engineer, Telegraph Department, London and North-Western Railway Company, Chester

Andrews & Co, Electric Light Engineers and Art Metal Workers, 224 and 226, Tottenham Court-rd, London, W.

ANDREWS (J. D. F.) & CO, Electricians and Engineers, Manufacturers and Contractors, 15, Marsham-st, Westminster, London, S.W.; 12, Waterloo-st, Glasgow; 24, Grainger-st West, Newcastle-on-Tyne; and 60, Castle-st, Liverpool

*Andrews, J. D. F., Electrical Engineer, 15, Marsham-st, London, S.W.

Andrews, Leonard, Electrical Engineer, 20A, South-ter, Hastings

Andrews, H. J., Electrician, 184, Iverson-rd, Kilburn, London, N.W.

Andrews, J., Electrician, Park-rd, Spalding

Andrews, O. M., Distributing Engineer, St. James's and Pall Mall Electric Light Company, Limited, Mason's-yard, Duke-st, London, S.W.

Andrews & Preece, Limited, Electrical Engineers and Contractors, Borough Mills, Manchester-rd, Bradford. (*Boromil Bradford, 544*)

See also page 274.

Andrews & Sons, Sanitary Engineers and Electric Bell Fitters, 140, High-st, Watford. (*Andrews Watford*)

Andrews (Thomas) & Co, Manufacturers of Forgings, Castings, &c., Wortley Iron Works, near Sheffield

Andrews, Thomas, F.R.S., Electrician, Wortley Iron Works, near Sheffield

Andrews, Thomas Newton, Electrician, Charles School of Science, Plymouth

Andrews, W., Chairman of the Western and Brazilian Telegraph Company, Limited, and Managing Director Indo-European Telegraph Company, 18, Old Broad-st, London, E.C.

Andrews, Wm., Electrician, 6, St. Ann's-valley, Nottingham

Anglo-American Construction Company, Limited, Electric Light Contractors and Engineers, 9, New Broad-st, London, E.C. (*1078*)

ANGLO-AMERICAN TELEGRAPH COMPANY, Limited, 26, Old Broad-st, London, E.C. Stations: 23, Throgmorton-st (*11028*), 109, Fenchurch-st, and 46, Mark-lane, E.C., 2, Northumberland-avenue, Charing Cross, S.W. (*3598*), and Hay's Wharf, Tooley-st, S.E., London; A1, The Exchange, Liverpool; 7, Royal Exchange, Manchester; 10, Forster-sq, Bradford; 1, Side, Newcastle-on-Tyne; Back Hall-chmbrs, Baldwin-st, Bristol; 29, Gordon-st, Glasgow (*943*); 106, George-st, Edinburgh (*400*); Exchange-bldgs, Leith (*600*); and 1, Panmure-st, Dundee. **See Advt., p. cxxvii.**

Marquis of Tweeddale — Chairman
F. A. Bevan... ... ... — Deputy Chairman
J. H. Carson ... ... — Manager
T. H. Wells ... ... — Secretary

See also AMERICAN DIVISION *and page 275*

Anglo-Portuguese Telephone Company, Limited, 53, New Broad-st, London, E.C.; 60, Travessa Sta. Justa, Lisbon; 14, Rua de Ferreira Borges, Oporto. (*Diphda London; Edison Lisbon; Edison Oporto*)

Sir A. Armstrong, K.C.B. — Chairman
R. Rodgers ... ... — Secretary
Alan Danvers ... ... — Managing Director in Portugal

See also page 275

Angold, Arthur Ernest, Electrician, 12, Jamesgrove, Peckham, London, S.E.

Angus (Geo.) & Co, Limited, Leather and India Rubber Manufacturers, St. John's Works, Grainger-st West, Newcastle-on-Tyne; and 9, Lime-st, London, E.C. (*Angus Newcastle*)

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Annenberg, Israel, India Rubber Manufacturer, 273, Commercial-rd East, London, E.

Ansell, Fredk. Graham, F.C.S., Analytical Chemist and Electrical Engineer, Wickwar, Gloucestershire

Ansell, H. W., Electrical Engineer, 26, Merton rd, Wimbledon

*Ansell, Wm. T., F.R.G.S., Winchester House, 50, Old Broad-st, London, E.C.

Anstey & Son, Wood and Ivory Turners, 53, East-road, City-rd, London, N.

Anti-Attrition Metal Company, Limited, Bearing Metal Manufacturers, Emerson-st, Southwark, London, S.E.

Anns, Albert, Secretary of the National Telephone Company, Limited, Oxford-ct, Cannon-st, London, E.C. (*9616*); and Kenmore, Lennard-rd, New Beckenham, Kent

Appleby Bros, Engineers and Crane Builders, 22, Walbrook, London, E.C. (*Millwright London*)

Applegarth, Robert, Electrical Engineer, 11, Queen Victoria-st, London, E.C.

Appleton, Burbey & Williamson—*now* Burbey, Williamson & Joseph (*q.v.*)

Apps, A., Maker of Surveying and Electrical Instruments to the Government, 433, West Strand, London, W.C.

Arc Accumulator Company, Limited, 99, Cheapside, London, E.C.

See also page 275

Archbutt, W. E., Electric Bell Manufacturer, 201, Westminster Bridge-road, London, S.E.

Archdale (James) & Co, Machine Tool Makers, Manchester Works, Ledsam-st, Birmingham; and 23, College-hill, London, E.C. (*Archdale Birmingham; Colloquial London*)

Archer Pipe Company, Limited, Makers of Stoneware Patent-jointed Pipes for Underground Wires, &c., 19, Great George-st, London, S.W. (Robert Ewing, Managing Director)

Archer (W. F.) & Sons, Electric Bell and Electric Fittings Manufacturers, 43 and 49, Lord-st, Liverpool

Arculus (Alfred) & Co, Manufacturers of Globes and Shades for Electric Lighting Purposes, 295, Broad-st, Birmingham. (*Arculus Birmingham, 910*)

Ardeer Foundry Company, Engineers and Ironfounders, Stevenston, Ayrshire, N.B. (*Kerr Stevenston*)

Ardley (A.) & Son, Electric Light Contractors, 48, Cannon-st, and Wormwood-st, and Duke-st, Houndsditch, London, E.C. (*4231*)

Ardron, J., A.I.E.E., Secretary's Office, G.P.O., St. Martin's-le-Grand, London, E.C.

Ariel Company, Limited, Manufacturing Electrical Engineers, 25, Garlick-hill, London, E.C. (S. S. Allin, Manager)

Arkell, B., Electrician, c/o P. and O. Steam Navigation Company, Leadenhall-st, London, E.C.

Armfield (Joseph John) & Co, Consulting Engineers, Makers of the British Empire Turbine, 20, Mark-lane, London, E.C.: and Vale of Avon Ironworks, Ringwood, Hampshire

Armistead, William, Electrician, 15, Rupert-st, Wolverhampton

Armitage, J. V., Electrical and General Engineer and Millwright, St. Ann's Works, Salisbury

Armitage (Sir Elkanah) & Sons, Limited Manufacturers of Cotton Duck Belting, 48, Mosley-st, Manchester; and 8, Milk-st-bldgs, Cheapside, London, E.C. (*Elkanah Manchester, 1150; Elkanah London*)

Armour, L. H., C.E., Civil and Electrical Engineer, 16, West-st, Gateshead-on-Tyne

Armstrong, Sir A., K.C.B., Chairman Anglo-Portuguese Telephone Company, the Edison-Gower-Bell Telephone Company of Europe, and Director of the Consolidated Telephone Construction and Maintenance Company, 53, New Broad-st, London, E.C.

Armstrong, Addison & Co, Makers of Telegraph Poles, Sunderland

Armstrong, Alfred W., Electrician, London and Hampstead Battery Co, 15A, Fitzjohn's Pavement, Finchley-rd, and 33, Chapter-rd, Willesden Green, London, N.W.

Armstrong, Col. R. Y., R.E., M.I.E.E, Junior United Service Club, Charles-st, London, S.W.

Armstrong, Prof. Geo. Frederick, M.A., F.R.S.E., M.Inst.C.E., Professor of Engineering, The University, Edinburgh

Armstrong, Prof. Henry E., Ph.D., F.R.S., President of the Chemical Society, and Professor of Chemistry, City and Guilds of London, Central Institution, Exhibition-rd, London, S.W.

Armstrong, Rt. Hon. Lord, C.B., F.R.S., 8, Great George-st, Westminster, London, S.W.

Armstrong (Sir W. G.), Mitchell & Co, Limited, Mechanical Engineers, Shipbuilders, &c., Elswick Works, Newcastle-on-Tyne.; and 8, Great George-st, Westminster, London, S.W. (*Elswick Newcastle-on-Tyne, 8; Jesmond London, 3229*)

Armstrong, Stevens & Son, Manufacturers of Screws, Nuts and Bolts, Birmingham. (*Armstrongs Birmingham*)

Armstrong's Glass Company, Limited, Manufacturers of Specialities in Glass for Electrical Purposes, 26, Waterloo-st, Birmingham.

Army Contracts, Director of, War Office, London, S.W. (*Army Contracts London*)

Arney, Mrs. Harriet, Wire Drawer, 23, Ironmonger-row, London, E.C.

Arnold, Son & Co., Consulting Electrical and Mechanical Engineers, 15, Cross-st, Islington, London, N.

Arnold & Sons, Electrical and Medical Instrument Makers, 31, West Smithfield, and 1, 2 & 3, Giltspur-st, London, E.C. (*Instruments London, 6518*)

Arnot, William, Assoc.M.Inst.C.E., M.I.E.E., Electrical Engineer to the Glasgow Corporation, City-chmbrs, George-sq, Glasgow. (*Induction Glasgow*)

Aronsberg, W., Maker of Galvanic and Magneto-Electric Machines and Mathematical Instruments, 12, Victoria-st, Manchester

Aronsen, Joseph N., Electrician, 38, Warwick-st, Regent-st, London, W.

Arrol (Sir William) & Co, Limited, Engineers, Dalmarnock Iron Works, Baltic-st, Glasgow. (*Tay Glasgow, 2519*)

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Art Metal Manufacturing Company, Manufacturers of Electric Light Fittings, 42, Lamb's Conduit-st, London, W.C.

Art Workshops, Limited—*in liquidation*

Asbestos Company (The United), Limited, Dock House, Billiter-st, E.C., and 158 & 160, Charing Cross-rd, London, W.C.; and 34, Deansgate, Manchester. (*Asbestos London*)

Ash, A. D., Electrician and Switch Maker, Wood-st, Willenhall, Staffs.

Ash, Gill & Co, Electro Platers and Metallurgists, Bletchworth Works, Birmingham

Ash, William H, Superintendent Eastern Telegraph Company, Portheurno, Treen, R.S.O., Cornwall

Ash's Stores, Electric Light Contractors, Bournemouth

Ashbury Railway Carriage and Iron Company, Ltd, Makers of Cars for Electric and Light Railways, Openshaw, Manchester; and 1, Westminster-chbrs, Victoria-st, London, S.W. (*Ashburys Manchester, Nat. 5118*)

Ashby, G. F., Electrical Bell Manufacturer, 184, King's-rd, Chelsea, London, S.W.

Ashby, Morris, Limited, Metal Merchants, 17, Lawrence Poutney-lane, London, E.C. (*Ashby London*)

Ashford & Brooks, Engineering Agents, King Alfred's-pl, Birmingham; and 153-4, Gresham House, Old Broad-st, London, E.C. (*Ashbrook Birmingham*; *Ashbrook London*)

Ashlin & Co, Consulting Engineers, 34, Leadenhall-st, London, E.C.

Ashmore, H. L., Electrician, National Telephone Co, Oxford-ct, Cannon-st, London, E.C.

Ashton, E., Superintendent Engineer, Postal Telegraphs, Glasgow

Ashton & Green Iron Company, Galvanisers, 11-15, Bury-st, St. Mary-axe, London, E.C.; and at Stratford (Essex), Bristol and Norwich. (*Ironmaster London, 615*)

ASHTON, GREEN, MATHEWS & CO, Manufacturers (to H.M. Government) of Slate Slabs, Bases, Switch-boards, &c., 61, St. Mary-axe, London, E.C.; Temple-gate, Bristol; and Aberllefenny, N. Wales. (*Timists London*)

Ashton, John, District Manager, National Telephone Co, 44, Moy-rd, Roath, Cardiff. (*673*)

Ashton (John) & Son, Belting Manufacturers, 36, Withy-grove, Manchester (*1327*); and Hyde-rd, Gorton (*1327a*) (*Straps Manchester*)

Ashworth, A. & H. H., Belting Manufacturers, Grove Works, Ashworth-st, Bury New-rd, Higher Broughton, Manchester. (*Sizing Manchester*)

Ashworth (G. L.) & Bros, Manufacturers of Insulators Porous Ware and Electrical Potteries, Broad-st, Hanley, Staffs.; and 21, Ely-pl, London, E.C. (*Ashworth Hanley, 35*)

Askew, Frank, Practical Electrician, 15, Norfolk-st, Southsea, Hants

Askham Bros. & Wilson, Limited, Engineers, Yorkshire Steel and Engineering Works, and Crucible Steel Foundry, Sheffield. (*Askham Sheffield, N. 213*)

Aspinall's Enamel, Limited, Makers of Enamel for Insulating Purposes, North-rd, New Cross, S.E., and 65, New Broad-st, E.C., London. (*Aspinall's Enamel London, 8042*)

Aspinall, F. B., Electrician, 39, Bennett-park, Blackheath, London, S.E.

Asquith & Co., Ltd., General Engineers and Merchants, Throgmorton House, Copthall-avenue, London, E.C. (*Asquith London*)

Asquith, W., Machine Tool Specialist, Highroad Well Works, Halifax

Association for the Protection of Telephone Subscribers, 58, Coleman-st, London, E.C. (C. W. Rawlinson, Secretary)

See also page 275

Astbury, W. H., Engineer, Lathe and Tool Maker, Grantham. (*Astbury Grantham*)

Astley (John) & Sons, Limited, Manufacturers of Electrical and Scientific Apparatus, 4, Broadgate, and Hales st, Coventry

Aston Chemical Company, Makers of Boiler Non-Conducting Composition, Aston, Birmingham

Aston & Mander, Mathematical Instrument and Slide Rule Makers, 25, Old Compton-st, London, W.

ATKINS (CHAS.) & NISBET, Agents for Continental Manufacturers of Electrical Accessories, Screws and Terminals, Drawn Brass and Iron Rods, 1, Water-lane, Great Tower-st, London, E.C. **See Advt., p. 634**

Atkins, H. C., A.R.S.M., Lecturer on Electrical Engineering and Applied Electricity in the Municipal Technical School, Birmingham.

Atkinson, C. W., Engineer to the Electrical Coal Cutting Contract Corporation, Limited, 2, St. Nicholas-bldgs, Newcastle-upon-Tyne

Atkinson, Dr. E., F.C.S., Treasurer of the Physical Society, Portesbery Hill, Camberley, Surrey

Atkinson, Hans Edwin B., Electrician, 82, Seymour-st, Hyde Park, London, W.

*Atkinson, Llewelyn B., Civil and Electrical Engineer (Messrs. W. T. Goolden & Co), Woodfield Works, Harrow-rd, London, W.

Atkinson, —, Manufacturer of Dynamo Castings, Holly-rd, Handsworth, Birmingham

Atlas Carbon Manufacturing Company, Limited, Battery and Carbon Makers, 19, Ewer-st, Southwark, London, S.E. (*Emerine London*)

See also page 275

Atlas Engineering Company, Manufacturers of Machine Tools, &c., Levenshulme, Manchester (*Atlas Levenshulme*)

Attfield, Prof. John, F.R.S., &c., Teacher of Chemistry, Consultant and Analyst, 17, Bloomsbury-sq, London, W.C.

Attwater (R. H.) and Sons, Asbestos, India-rubber, and Engine Packing Manufacturers, Preston, Lancs.

Attwaters, W., Electrical Engineer, 29, Aberdeen-walk, Scarborough

Aubert, Wm., jun, Electric Light Contractor, Bank-bldgs, St. Bride's-st, London, E.C.

Audio Telephone Mouthpiece Company, Makers of the Audio Telephone Mouthpiece, 67, East Howard-st, Glasgow

Aurora Electric Lighting and Distribution Company, Limited, Electric Light Engineers and Contractors, 54, New Broad-st, London, E.C.

See also page 275

Austin and Myers—*in liquidation*

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Auto-Machinery Company, Limited, Manufacturers of Steel Balls for Dynamo Bearings, Read-st, Coventry; and 14, Holborn-viaduct, London, E.C. (*Auto Co. Coventry*)

Automatic Electric Machine Company, Manufacturers of Electrical Apparatus, 47, Victoria-st, London, S.W.

Automatic Electric Railway Signal Company, Limited, Patentees of Automatic Electric Railway Signals, 11, Rumford-pl, Liverpool. (J. Harvey Evans, Secretary). (*Harvoso Liverpool*)

See also page 275

AUTOMATIC STANDARD SCREW COMPANY, Makers of Screws and Terminals, Halifax. (H. Ling Roth, Manager.) (*Standard Halifax*) **See Advts., pp. 611 and 634**

Automatic Electrical Corporation, Limited, Electric Light Engineers and Contractors, 154, Winchester House, Old Broad-st, E.C.

Automatic Heat Regulator and Fire Alarm Company (The Patent), Manufacturers of Electric Fire Alarms, Heat Indicators and Regulators, Edmund-st, Birmingham

Aveling & Porter, Makers of the Compound Portable and Road Engine and Dynamo, &c, Rochester, Kent; and 72, Cannon-st, London, E.C. (*Aveling Rochester*)

Avey, C. H., Electrician, 181, Wick-rd, Homerton, London, N.E.

Avery (W. & T.), Limited, Electrical Apparatus Makers, Digbeth, Birmingham (*Avery Birmingham*); 14, 15, and 16, Cow-cross-st, Smithfield, London, E.C. (*6708*); and at Manchester, Leeds, Glasgow, and Cardiff

Axford, James Tobias, Consulting Engineer, 9, London-st, London, E.C. (*Voltzine London*)

Axworthy, W. H., Secretary to the Pacific and European Telegraph Company, Limited, 212, Winchester House, Old Broad-st, London, E.C.

AYLMER, RICHARD, M.Inst.C.E., A.I.E.E. Electrical Engineer 47, Victoria-st, London, S.W. (*Leclanché London*) **See Advt., p. 17**

Sole Agent for Leclanché's Patent Batteries.

***Ayrton**, Prof. W. E., F.R.S., Consulting Electrical Engineer, City and Guilds of London Central Institution, Exhibition-rd, S.W., and 41, Kensington Park-gdns, W., London (*8560*)

Azores Gas and Electric Light Corporation, Limited, 62, King William-st, London, E.C.

— B —

Babcock & Wilcox, Limited, Engineers and Boiler Makers, 21, Bothwell-st, Glasgow; **147**, Queen Victoria-st, London, E.C.; and **28**, Deansgate, Manchester (Walter Shaw, Secretary) (*Babcock London, 1561; Babcock Glasgow; Babcock Manchester*)

See also page 275

Backhouse, E. E., Electrician, 9, Chantry-rd, Saxmundham, Suffolk

Bacon, Lieut. G. R., Electrician, H.M.S. "Vernon," Portsmouth

Bacon, T. Walter, Electrician, 4, Great Winchester-st, London, E.C.

Baerlein & Co, Engineers and Copper Merchants, 12, Blackfriars-st, Salford, Manchester (*Baerlein Manchester, 503*)

Baggett, R., Electrical Apparatus Maker, 3, Henry-st, Vauxhall, London, S.E.

Bagley, —, Maker of Insulators, Battery Cells, &c., Great Northern Goods Depot, King's Cross, London, N.; and Knottingley, Yorks.

Bagnall (W. G.), Limited, Steam Engine Makers, Castle Engine Works, Stafford; and 7A, Laurence Pountney-hill, London, E.C. (*Bagnall Stafford, 15*)

Bagnold, Arthur Henry, Major R.E., Instructor in Electricity at the School of Military Engineering, St. Mary's Barracks, Chatham. (*Bagnold Military School Chatham*)

Bagot, Henry Wilson, Electrician, Faraday Electric Works, Campbell-st Govan, Glasgow

BAGSHAWE BROS & CO, Engineers, Merchants and Manufacturers, 4A, Upper Thames-st, London, E.C. (*Outburst London.*) **See Advts., pp. 606 and 617**

Bagshaw (J.) & Sons, Limited, Pulley and Shafting Manufacturers, Batley, Yorks. (*Bagshaw Batley*)

Bailey, Alfred J., Electrician, Tremere, Sylvan-rd, Upper Norwood, S.E.

Bailey, Frank, Engineer to the Metropolitan Electric Supply Company, Limited, 17, South-st, Manchester-sq, London, W.

Bailey, G. H., Electrician, 220, Temple-chmbrs, Temple-avenue, London, E.C.

*Bailey, John, Manager, India Rubber, Gutta Percha, and Telegraph Works Company, Limited, Silvertown, Essex

Bailey (M.) & Co, Experimental Glass Blowers, 32 and 34, Buckingham-rd, Kingsland, N., and 2, Station-bldgs, Acton-st, Haggerston, N.E., London

Bailey, Pegg & Co, Metal Merchants, 81, Bankside, London, S.E.; and Brierley Hill, Staffs.

Bailey (S. G.) & Co, Manganese and Carbon Merchants, Stafford Mills, Stroud, Gloucestershire. (*Manganese Stroud*)

Bailey (W. H.) & Co, Limited, Makers of Steam Engines, &c., Albion Works, Salford, Manchester. (*Beacon Salford, 991*)

Bailie, J. D., Electrical Engineer (Yorkshire Representative of Messrs. C. A. Parsons & Co), 13, Peacock's-bldgs, Park-row, Leeds (*Turbo Leeds, 1194*)

Baily, F. G., M.A., Electrical Engineer and Lecturer in Electrotechnics, University College, Liverpool

Baily, Grundy & Barrett, Limited, Electrical and General Engineers, 2, St. Mary's-passage, and (Works) Magdalene-st, Cambridge

See also page 275

Baily and Grundy (London), Limited, Electrical and General Engineers, Amberley Works, Amberley-rd, Paddington, London, W. (*Amber London*)

R. M. Baily and A. Grundy...Man. Directors
G. A. Knight ... ...Secretary

See also page 275

Baily (William) & Sons, Art Metal Workers, 71, Gracechurch-st, London, E.C.

Bainbridge, Seymour & Co, Consulting and Mining Engineers, 13, St. Helen's-pl, London, E.C. (*Basera London, 11074*)

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Baird, Thompson & Co, Electricians, 22-26, Bath-st, Glasgow; and 159, Queen Victoria-st, London, E.C. (*Grahtryx Glasgow*; *Grahtryx London*)

Baird & Tatlock, Chemical and Electrical Appliances Manufacturers, 40, Renfrew-st, Glasgow (*Technical Glasgow, 3967*); and 14, Cross-st, Hatton-gdn, London, E.C. (*6749*)

Baird, Thomas, Electrical Instrument Maker, 34, Queen-st, Glasgow

Baird, John, Maker of Electric Light Shades, 71, Bishop-st, Port Dundas, Glasgow

Baker, Sir Benjamin, K.C.M.G., Consulting Engineer to the City and South London Railway Company, 2, Queen-sq-pl, Westminster, London, S.W. (*3055*)

Baker Blower Engineering Company, Limited, Engineers, Makers of Blowers, Exhausters, Iron and Steel Castings, Stanley Works, Sheffield (*Elivas Sheffield, 1027*)

Baker & Co, Electrical Engineers, Sexton-st, and 19, Crescent, Limerick (*Walker Limerick*)

Baker, C. Ashmore, Electrical Engineer (Poole & White, Limited), 47, Russell-road, Kensington, London, W.

Baker, Charles L., Electrical Engineer, Maskelyne Typewriter Co., Limited, 41, Holborn Viaduct, London, E.C.

Baker, Edward, Manager of the Gas Works, Reading (*Baker Gas Works Reading*)

Baker, George Henry, Electrical Engineer, 16, Lodge-rd, Southampton

Baker, Hill & Co., Electrical Engineers, 1, Broad-st., Oxford

Baker, J., Electrical Instrument Maker, 24, Chatto-rd., Battersea, London, S.W.

Baker (John) & Co, Manufacturers of Castings, &c., Brinsworth Iron and Steel Works, Rotherham (*Brinsworth Rotherham*)

Baker (Joseph) & Co, Gas and Oil Engine Makers, 58, City-rd, London, E.C.

Baker (Richard), Son & Co, 6 and 7, Cross-lane, Eastcheap, London, E.C. (*Fornajo London*)
Specialists and Agents for the sale and purchase of Mica and rare Mineral Products, Rock Crystals, &c.
(*Removed from 9, Mincing-lane*)

Baker, T. W., Electrical and General Engineers, 25, Wormwood-st, E.C., and (Works) 2, Drysdale-st, Hoxton, N., London

Baker, W. S. Graff, Managing Director, of the Electric and General Contract Corporation, Limited, 35, Parliament-st, Westminster, London, S.W. (*Carwheel London*)

Baker, —, Manufacturer of Electro-Plating Apparatus, 60, High-st, Wandsworth, London, S.W.

Bakewell, William, Electrical Engineer, Shortridge-st, Attercliffe, Sheffield

Balderston & Co, Leather Belting Manufacturers, 201, St Vincent-st, Glasgow. (*Balderston Glasgow*)

Baldwin, E. P. & W., Makers of Coke and Charcoal Iron and Steel Sheets, Tin Plates, &c., Wilden, near Stourport. London Agents: Brooker, Dore & Co, Corbet-court, Gracechurch-st, E.C. (*Wilden Stourport*)

Ball Bros. & Bates, Electrical Engineers, 118, Holborn, London, E.C.

Ball, Edwin W., Electrical and Scientific Instrument Maker, 25, Cambridge-st, Birmingham (*Ball Crescent Birmingham*)

Ball (F. W.) & Co, Electrical Engineers, Bristol

Ball (John) & Co, Manufacturing Electrical Engineers, 48, New Bridge-st, Leicester

Ball, Joseph, Lightning Conductor Manufacturer, York Castle, Oldham. (*Castle Oldham, 23*)

Ball, T., Manufacturer of Dynamo Castings, Golden-cross, Colnbrook, Bucks.

Ballard, W. H., Telegraph Engineer, Postal Telegraphs, Plymouth

Balloon Society of Great Britain, The, 26, Budge row, Cannon-st, London, E.C. (W. H. Le Fevre, President; Frank Harger, Secretary)

Bambridge, G. H., General Superintendent in Great Britain of the Commercial Cable Company, Bishopsgate House, 55 and 56, Bishopsgate-st Within, London, E.C.

Banker, S. M., Electrician, Helvellyn, Brownlow-rd, Bounds Green, London, N.

Banks, B. R., Electro-Plater, 21 and 31, Deptford-broadway, and 1, Watson-st, London, S.E.

BANKS (W.) & CO, Limited, Electrical Engineers and Electrical and Scientific Apparatus Makers, 32, Corporation-st, Bolton. (*Banks Bolton*)

Bannister, C. F., Electrician, 40, Mornington-rd, Regent's Park, London, N.W.

Bannister, Richard, Analytical Chemist, The Laboratory, Somerset House, W.C., and 59, Tregunter-rd, South Kensington, S.W., London

Barber, Matthew Henry, Electrician, Ash-villas, Trafford-rd, Alderley Edge, nr Manchester

Barber-Starkey, W. J. S., Consulting Electrician, Knockshandoch, Glen Isla, Alyth, N.B., and 30, Park-lane, London, W.

Barclay & Son, Electric Light and Power Contractors, 138, Regent-st, London, W. (*3570*)

Barclay & Sons, Limited, Wholesale Chemists, 95, Farringdon-st, London, E.C. (*Valerab London*)

Barclay, W. J., Electrical Engineer, 59, West Clowes-st, Salford

Bardill (D. W.) & Co, Limited, Manufacturers of, and Dealers in, Electrical Apparatus, Derby; and at Burton-on-Trent

Barker, Albert, Limited, Electricians, 9, Great Newport-st, London, W. (*Albert Barker London*)

BARKER, CHAS. D. (London Agent of Price, Sons & Co), 113, Midland-rd, St. Pancras, London, N.W. (*7696*) **See Advt., p. 580**

Barker, Edward Raymond, M.I.E.E., India Rubber, Gutta Percha, and Telegraph Works Co, Limited, Silvertown, London, E.

BARKER (FRANCIS) & SON, Compass Makers, 12, Clerkenwell-rd, London, E.C. **See Advt., p. 462**
Manufacturers of Special Magnetic Compasses for Electrical Purposes, Needles and Jewel Holes.

Barker, John H., A.M.I.C.E., Electrical Engineer, General Manager and Secretary, Cambridge Electric Supply Company, Limited, 2, Sidney-st, Cambridge. (*Electric Supply Cambridge, 43*)

Barley, C. J., Electrical Engineer, Chapel-place, Central Lighting Station, Brompton-rd, London, S.W. (*8587*)

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Barlow, H. D., Electrical Engineer, Messrs. J. & P. Coats, Limited, Paisley

Barlow, J. & W., Mechanical Engineers and Boiler Makers, Crawford-st, Rochdale (*Barlows Engineers Rochdale*)

Barlow, Thos., Assistant Controller, Central Telegraph Office, London, E.C.

Barlow and Son, Consulting Engineers, 2, Old Palace-yard, Westminster, London, S.W.

Barnard, A. S., Borough Electrical Engineer, Town Hall, Lancaster

Barnard, Bishop & Barnards, Limited, Art Metal Workers, 91-95, Queen Victoria-st, London, E.C.; and Norfolk Iron Works, Norwich. (*Barnards London; Barnards Norwich*)

Barnard (H. B.) & Sons, Anti-Friction Metal Makers, 144, Lambeth-walk, S.E., and Bridge Wharf, Burdett-rd, E., London, (*Metaleibles London*)

Barnes (Frederic) & Co, Exporters of Electrical and Telegraphic Plant, 109, Fenchurch-st, London, E.C. (*Fred Barnes London, 4393*)

Barnet and District Electric Supply Co, Limited, 31, Wilson-st, Finsbury, London, E.C.

Barnett, M. Pat., M.I.C.E., Telegraph Superintendent Great North of Scotland Railway Company, Aberdeen. (*376*)

Barnett (Rowland) & Co Electrical and General Engineers, Volt Works, Walkergate, and 8, Mosley-st, Newcastle-upon-Tyne (*Dynamo Newcastle, 6510*)

Barnett, Theo., Electrician, 14, Narcissus-road, West Hampstead, London, N.W.

Baron, James Thomas, Electrical Engineer to St Pancras Vestry, Central Station, 47, Stanhope-st, London, N.W.

Barr, Dr. Archibald, M.I.C.E., Consulting Engineer, Professor of Civil Engineering, The University, Glasgow

Barr, James Mark, Electrician, 38, Draytongrdns, London, S.W.

Barratt, Woodson & Co., Manufacturers of Friction Paste and of the Nonpareil Boiler Composition, 5, Flat st, Sheffield. (*Friction Paste Sheffield*)

Barrett, Arthur, Consulting Electrician, Messrs. Baily, Grundy & Barrett, Limited, 2, St. Mary's-passage, Cambridge

Barrett (R.) & Son, Limited, Brass, Gunmetal and Iron Founders, King's Head-ct, Beech-st, London, E.C. (*Gunmetal London, 513*)

Barrett, Tagant & Pochin, Lubricant Manufacturers, Corrisson Works, Fulham, London, S.W. (*Batafio London*)

Barrett, Prof. W. F., F.R.S.E., M.R.I.A., Professor of Physics, Royal College of Science, Dublin

Barrow Hematite Steel Company, Steel Wire Makers, 153, Fenchurch-st, London, E.C. (*Flecti London, 1529*).

Barry (Henry) & Co, Limited, Manufacturers of Shafting, Pulleys, &c., Aberdeen; and 3 and 4, Lime-street-sq, London, E.C. (*Barry Henry Aberdeen, Loborless London*)

Barry & Higham, Consulting Engineers, Broad-st House, Old Broad-st, London, E.C. (*Pintle London, 2421*)

Barry, John Wolfe, Consulting Engineer, 21, Delahay-st, Westminster, London, S.W.

Barter, Arthur, Electrical Engineer, 73, Vincent-sq, London, S.W.; and 22, Newcomen-ter., Cortham, Redcar

Barter, Charles, Electrician, 41, Banbury-st, Birmingham

Bartholomew, W., Electrical Engineer, Wardrobe-chmbrs, Queen Victoria-st, London, E.C.

Bartlett, Albert T., B.A., Electrical Engineer, 63, Mount-st, Charlton, Kent

Barton, Thomas, Electrical Engineer and Telephone Contractor, Ainsworth-st, Blackburn. (*Barton Electrician Blackburn, 265*)

Barwell, James, Electric Bell Manufacturer, 39 and 40, Great Hampton-st, Birmingham

Barwell (James), Sons & Co, Electric Light Fittings Makers, Clement-st, Birmingham; and 1, Holborn-circus, London, E.C. (*Metals Birmingham*)

Barwell (Wm.) & Son, Nut, Bolt, and Rivet Manufacturers, Hockley Bolt Works, Brookfields, Birmingham; and 26, Martin's-lane, Cannon-st, London, E.C. (*Barwell Birmingham, 104*)

Bashall, William, Engineer, 145, Cheapside, London, E.C.

Bassingham (Wm.) & Son, Electric Light Engineers, 49 and 51, Lower Whitecross-st, London, E.C.

Bassnett, Thomas, Limited, Ships' Telegraph and Scientific Instrument Manufacturer, 10, Bath-st, Liverpool. (*Manometer Liverpool*)

Bastin, C., Electrician, Amesbury-villa, Serpentine-rd, Poole, Dorset

Bastin & Lawson, Metal and Machinery Merchants, 49, Finsbury-pavement, London, E.C. (*Bastin London*)

Batchelor, Richard D., Artesian and Consulting Well Engineer, 73, Queen Victoria-st, London, E.C.; and Artois Works, Chatham. (*Borholes London; Batchelor Chatham*)

Bate, A. H., Electrician, Testing Department, Edison & Swan Company, Ponder's End, Middlesex

Bate & Co, Electric Light Engineers and Contractors, 14, Wormwood-st, London, E.C.

Bate, Douglas C., Electrical Engineer, 127, East Dulwich-grove, London, S.E.

BATE, R., Turner in Hard and Soft Woods, Ivory, Horn and Ebonite, 39½, Leather-lane, London, E.C. **See Advt., p. 647**

Bateman (John) & Co, Scientific Instrument Makers and Experimentalists, 205 & 206, High Holborn, London, W.C.

Bateman, Parsons & Bateman, Consulting Engineers, 39, Victoria-st, London, S.W.

Bates, Arthur, Asbestos Merchant, 31, Dutton-st, Manchester. (*Arthur Bates Manchester*)

Bates, Edwin (Ball Bros. & Bates), Electrical Engineer, 118, Holborn, London, E.C.

Bates, F. E., Electrical Engineer, 39, Victoria-st, London, S.W.

Bates, W. & A., Belting Manufacturers, St. Mary's Mills, Leicester; and 121, Stamford-st, London, S.E.

Bath (City of) Electric Lighting and Engineering Company, Limited—*see* City of Bath Electric Light and Engineering Company, Limited

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Bath (Henry) & Son, Metal Brokers and Commission Agents, 53, New Broad-st, London, E.C.; and at Liverpool and Swansea. (*Bathota London, 1364; Bathota Liverpool; Bath Swansea*)

Bathurst, William, Electrician, 11, St. Bee's-st, Moss Side, Manchester

Battersea Polytechnic Institute, Battersea, London, S.W.

Principal ... ... { Sidney H. Wells, Wh.S., A.M.I.C.E.

Principal Lecturer ... W. E. Sumpner, D.Sc.

Baugh, Edward E., A.I.E.E., Relay Office for West Irish Wires, Haverfordwest, Pem.

Baughan (W. H.) & Co, Electric Bell Makers, Charlbury, Oxfordshire. (*Baughan Charlbury*)

*Baur, Dr. C., Electrical Engineer, 81, Church-lane, Old Charlton, London, S.E. (*Baur Charlton*)

Bax, Captain E. Ironside, General Manager Westminster Electric Supply Corporation, Limited, Eccleston pl, London, S.W.

Baxendale, R., Electrician, 19, Wistaston-rd, Crewe

Baxendale & Co, Electrical Engineers, Millerstreet, Manchester; and Edinburgh. ("*Baxendales*" *Manchester, 900*; "*Baxendales*" *Edinburgh*)

Baxters, Limited, Mechanical and Electrical Engineers, Sandiacre, Nottingham. (*Baxters Sandiacre Nottingham*)

Bayley Brothers, Electric Light Fittings and Switch Makers, Sherborne Works, Selborne-st, Walsall. (*Bayley Brothers Walsall*)

Bayliss, Jones & Bayliss, Telegraph Pole Manufacturers, &c., Victoria Works, Wolverhampton; and London. (*Bayliss Wolverhampton; Lockfast London, 1889*)

Bayly, J. P., Engineer and Patent Agent, 18, Fulham-pl, Paddington, London, W.

Baynes, R. E., Electrician, Christ Church, and 2, Norham-gardens, Oxford

Baynes, Sydney W., Electrical Engineer, Bradford Corporation, Town Hall, Bradford

Bays, G. H., jun, Electrical Engineer, 21, St. John's, Wakefield.

Bazeley, Thomas, Chief Superintendent of Telegraphs, Postal Telegraphs, Cardiff

Beadle, Clayton, Analytical and Consulting Chemist, 4, New-ct, Lincoln's Inn, London, W.C. (*Chloem London*)

Beal, Arthur G., Electrician, Longford House, Holyhead, N. Wales

Beal, Ebenezer, Electrician, 167, Highfield-rd, Seeley, Manchester

Beale, B. R., M.A., Electrical Engineer and Managing Director of Messrs Swinburne & Co, Ld., Broom Hall Works, Teddington

Beale, W. St. John, Electrician, Woodville, Knighton, Radnorshire

Beard, George, Electric Bell Manufacturer, 22, Green-ter, Clerkenwell, London, E.C.

Beardshaw (J.) & Son, Steel Makers, Baltic Steel Works, Sheffield. (*Beardshaw Sheffield, 77*)

BEARE, T. HUDSON, F.R.S.E., M.I.C.E., Testing and Consulting Engineer, Engineering Laboratory, University College, Gower-st, London, W.C.

Beauchamp, J. W., Electrician, 29, Kelley-st, Kentish Town, London, N.W.

Beaumont & Co., Electricians, 101, Nunnery-lane, York

Beaumont, F. J., Electrical Engineer, 37, Stockwell Park-cres, Brixton, London, S.W.

Beaumont, George, Electrician and Electrical Agent, 27, Basinghall-st, London, E.C.

Beaumont, W. Worby, M.I.C.E., M.I.M.E., Consulting Engineer, 78, Fleet-st, London, E.C.

Beaven, C., Electrical and Mechanical Engineer, 160, Shepherd's Bush-rd, London, W.

Beazley, W. O., Electric Bell Fitter, 9, Hindon-st, Pimlico, London, S.W.

Beck & Co, Limited, General Engineers and Ironfounders, 130, Great Suffolk-st, London, E.C. (*Hydrant London, 4860*)

Beck, R. & J., Mathematical and Scientific Instrument Makers, 68, Cornhill, E.C., and Lister Works, Kentish Town, N.W., London. (*1161*)

Beck, W. H., F.C.I.P.A., Patent Agent, 115 and 117, Cannon-st, London, E.C. (*11312*)

Becker (F. E.) & Co, Electrical and Chemical Apparatus Makers, 33, 35, and 37, Hattonwall, Hatton-gdn, London, E.C.

Beckett, J. W., Telegraph Engineer, Postal Telegraphs, Lancaster

Beckh, George Adam, Wire Manufacturer, 5, London-wall-av, London, E.C.

Beckingsale & Co, Electrical Engineers and Contractors, 6, St. Swithin's-lane, London, E.C.

Beckingsale, E. W., Electrical Engineer, Westoe, Beaufort-rd, Surbiton

Beckmann & Co, Wire Manufacturers, 21, Finsbury-st, London, E.C.

Beddoe, Charles George, Electrician, 29, Nine Elms lane, London, S.W.

Beddoe (Thomas) & Co, Engineers and Oil Merchants, Station-road, Spa-rd, London, S.E.

Bedford Electric Light Company, Limited, Electric Light Contractors and Suppliers, 3, St. Paul's-sq, Bedford. (Sir H. C. Mance, C.I.E., Chairman)

See also page 275

Bedford Engineering Company, Engineers and Crane Builders, Bedford. (*Cranes Bedford*)

Bedford, Henry Edward, Consulting Engineer, 1, Holborn-circus, London, E.C.

Bedford, H. W., Maker of Non-Magnetic Watches, 67, Regent-st, London, W.

Bedford, Steer, End & Co, Wire Drawers, Workers and Weavers, 78 to 90, Long-lane, London, S.E.

Bedson Wire Company, Limited, Wire Manufacturers, Royal Exchange, Middlesbrough. (*Bedsons Middlesborough, 5137*)

Beebee, Wm., Electrician, Walsall Electrical Company, Limited, 57, Bridge st, Walsall

Beech & Welch, Telegraph Instrument Case Makers, 69, Dalston-lane, London, N.E.

Beechey, Chas., Consulting Engineer, 39, Chapel Walks, Liverpool

BEESLEY (W. T.) & CO, Limited, Cold Rolled Steel and Steel Wire Manufacturers, Attercliffe-rd and Effingham-st, Sheffield. (*Beesley Sheffield, 1399*) **See Advt., p. 618**

Beesley & Wright, Engineers and Patent Furnace Makers, 14, Castle-st, Liverpool

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Beeton, H. R., Chairman House-to-House Electric Light Supply Company, Limited, Richmond-rd, Earl's Court, London, S.W.

Beeton, S., Electrical Engineer, "Heathfield," Haverstock-hill, London, N.W.

Beevor, S. F., A.I.E.E., 25, Leinster-sq, London, W.

Behr, F. B., Inventor of the Lightning Express Railway Service, 10, Drapers-gdns, London, E.C. (*Behr London, 190*)

Beldam, Asplan, Consulting Engineer, 77, Gracechurch-st, London, E.C.

Beldam Packing & Rubber Company, Asbestos Manufacturers, 77, Gracechurch-st, London, E.C. (*Corrugated London*)

Belfast Electric Appliances Company, Limited, Manufacturers of Electric Light Fittings, Castle Lane-place, Belfast

Belfield, Reginald, Electrician, Westinghouse Electric Co, Ltd., 32, Victoria-st, London, S.W.

Belgian Glass Company (John Berry & Co), Glass Globe Makers, 5, Union ct, Old Broad-st, London, E.C.

Bell, A., Manufacturer of Dynamo Castings, &c., Benson-st, Linthorpe, Middlesborough

Bell, Andrew, Telegraph Engineer, 14, Argyle-cres, Portobello, Midlothian

Bell, Charles, Sole Agent for the Ericsson Bell Telephone, 29, Waterloo-st, Glasgow. (*Charles Bell Glasgow*)

Bell (George) & Sons, Technical Publishers, York-st, Covent Garden, London, W.C. (*Bohn London*)

Bell, H., India Rubber Maker, Guildford-st, York-rd, and 154, York-rd, London, S.E. (*Advantage London*)

Bell, Horatio, Telephone Engineer and Manager of the Greenock District National Telephone Company, Greenock

Bell, Philip H., Assistant Works Manager, Edison Swan United Electric Light Company's Works, Ponders End; and Wyvenhoe, St. Andrew's-rd, Enfield, Middlesex

Bell, Stuart, Electrical Engineer, Messrs. T. S. McInnes & Co., Limited, 86, York-st, and 341, Argyle-st, Glasgow. (*Bell c/o Indicator Glasgow, 3979*)

Bell, T. W., Acid Manufacturer, Eagle Chemical Works, Chrisp-st, Poplar, London, E. (*5008*)

Bell, Watson, Electrical Engineer and Contractor, Whitehaven

Bellamy, John, Iron Telegraph Buoy Maker, Byng-st, London, E. (*Bellamy London, 5157*)

Bellchambers, G., Glassblower, 71, Ronald's-rd, Holloway-rd, London, N.

Bellew, R., Electrician, 51, Portland-pl, London, W.

BELLISS (G. E.) & CO, Limited, Engineers and Boiler Makers, Manufacturers of High-speed Engines for Electric Lighting, Ledsam-street Works, Birmingham; and 9, Victoria-st, London, S.W. (*Belliss Birmingham, 3518.*) **See Advt., p. 558**

Bell's Asbestos Company, Limited, Asbestos Manufacturers, 59½, Southwark-st, London, S.E. (*Belfry London, 4523*)

Belsham, Maurice, Consulting Engineer, Price & Belsham, 52, Queen Victoria-st, London, E.C. (*Belsham London*)

Belshaw (T. O.) & Co, Electrical Engineers, 53, Victoria-st, London, S.W.

Bendon (George) & Co, Scientific Instrument Makers, 36 and 37, Ely-pl, and 1, Charterhouse-st, London, E.C.

Benedict, W. Charles, Electrician, 59, Newington-butts, London, S.E.

Benest, Henry, Electrician, 15, Campbell-rd, Bow, London, E.

Benetfink & Co, Electric Light Contractors and Fittings Manufacturers, &c., 89, 90, 107, and 108, Cheapside, 1, Ironmonger-lane, and 8, Honey-lane-market, London, E.C.

BENHAM & FROUD, Limited, Art Metal Workers, and Makers of Electric Light Fittings, 40-42, Chandos-st, Strand, London, W.C. (*Benfro London*)

Benham & Sons, Limited, Electric Light and Bell Contractors, 66, Wigmore-st, London, W. (*Benham London, 7065*)

Benn, H. H., B.A., Electrical Engineer and Contractor, Lynmouth, North Devon.

*BENNETT, ALFRED ROSLING, General Manager and Engineer, New Telephone Company, 22, St. Alban's-rd, Harlesden, London, N.W. (*7455*)

Bennet (A. W.) & Co, Electrical Engineers and Contractors, Dynamo Works, 37, Park Cross-st, Leeds. (*Dynamo Leeds*)

Bennett (J.) & Sons, Engineers and Electricians, St. Neots

Bennett (J. M.) & Sons, Makers of the "Goehring" Mouldings, Ardwick Station, Hyde-rd, Cornbrook, Manchester. (*Timber Manchester*)

Bennett, R. C., Manager National Telephone Company's Exchange, and Victoria st, Nottingham. (*400*)

Bennett, Richard George, Electrical Engineer, 9, Kelmscott-rd, Wandsworth Common, London, S.W.

Bennett Sir John, Limited, Non-Magnetisable Watch Makers, 65, Cheapside, London, E.C. (*Horologist London*)

Bennett, Sons & Shears, Limited, Brass and Iron Founders, 167 and 169, Kingsland-rd, London, N.E. (*Coppersmiths London*)

Bennett, Thomas, Electrician, Cuba Cottage, Turner's-hill, Cheshunt

Bennett, Walter, Spelter Manufacturer and General Metal Merchant, 60, Gracechurch-st, London, E.C. (*Benett London*)

Bennett & Druce, Electrical Engineers, 44, Fishergate, Preston; and at Blackpool, Burnley, and Nottingham (*Consult Preston, 182*)

Bennie, John, Electrical Engineer and Maker of Engines for Electric Lighting, Star Engine Works, 149-155, Moncur-st, Glasgow. (*1111*)

Bennie, J. R., Mechanical and Chemical Engineer, 35, Queen Victoria-st, London, E.C. (*Industria London*)

Bennis (Ed.) & Co, Limited, Mechanical Engineers and Steam Engine Makers, Lancashire Stoker Works, Bolton, Lancs.; 49, Queen Victoria-st, London, E.C.; and at Glasgow and Cardiff. (*Bennis Bolton*)

Benson, J. W., Maker of Non-Magnetisable Watches, 62, Ludgate-hill, E.C. (*3584*)

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BENSON (W. A. S.) & CO, Makers of Electric Light Fittings, 82 and 83, New Bond-st (*5701*), and 2, Dering-st, London, W. Works: Hammersmith (*8637*)

Bentley & Co, Electricians, 17, Newton-st, Piccadilly, and 27, Bootle-st, Deansgate, Manchester

Bentley, Arthur, Electrical Engineer, Electric Construction Co, Limited, Ferdinand-st, Kentish Town, London, N.W.

Bentley, Wallace, Mechanical Draughtsman and Machinery Agent, Royal Insurance-bldgs, Crossley-st, Halifax. (*Bentley Draughtsman Halifax*)

Benton & Stone, Brass, Copper, and German Silver Tube Manufacturers, Aston Brook Tube Mills, Birmingham. (*Enots Birmingham, 246 and 2539*)

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*; A.B.C. Code)
Electrical Engineers and Manufacturers, Suppliers of Electrical Instruments, Materials, Accessories, and Specialities to the Trade.

Beresford, Charles F. C. Major R.E., M.I.E.E., Telegraph Engineer, South Camp, Aldershot

Beresford, James, Electrician, Messrs. Richard Johnson & Nephew, Manchester

Berger (Lewis) and Sons, Limited, Paint Makers, 7, Well-court, Queen-st, E.C., and (Works) Homerton, N.E., London. (*Lewberg London*)

Bergtheil, Arthur (Bergtheil and Young), Consulting Electrical Engineer, 13, Walbrook, London, E.C.

Bergtheil & Young, Electrical Engineers and Contractors, 13, Walbrook, London, E.C.
(*See "Micanite," p. 578.*)

Berk (F. W.) & Co, Limited, Acid Manufacturers, 1, Fenchurch-av, E.C. (*4014*), and Abbey Mills Chemical Works, Stratford, E. (*5424*), London. (*Berk London*)

Berkley, George, Consulting Engineer, 57, Charing-cross, London, S.W.

BERLINER, J. (London Office, O. Berend & Co), 61, Fore-street, London, E.C. (*Yttrium London*)
Telephone Works. Every description of Supplies for Telephones.

Bernays, Joseph, M.I.C.E., Consulting and Mechanical Engineer, 96, Newgate-st, London, E.C. (*Anybers London*)

Berndorf Metal Works, German Silver Sheet and Wire Manufacturers, 25, Frederick-st, Birmingham; and at Sheffield. (*Berndorf Birmingham, 4048*)

Bernstein Electric Lamp Company, Limited, 40, Chancery-lane, London, E.C.

Bernstein, —, Electrical Engineer, Messrs. Andrews and Preece, Limited, Borough Mills, Manchester-road, Bradford

Beronius, King & Co, Leather Belting Makers, 91, Fore-st, E.C. (*Beronius London*)

Berrett, F., Electrician and Manager Electrical Department, Dollond & Co, 35, Ludgate-hill, and 62, Old Broad-st, London, E.C.

Berry, Albert E., Engineer and Tool Maker, Victoria-rd, Sowerby Bridge, Yorks. (*Machinery Sowerby Bridge, 277*)

Berry, E. H., Electrical Engineer, District Manager for Messrs. Spagnoletti & Crookes, St. James's Hall, Burnley

Berry (E. L.), Harrison & Co, Electrical Engineers and Contractors, Lyric-chmbrs, Whitcomb-st, London, W. (*Kathode London*)

Berry, F. C., Electrical Engineer, 22, Denmark-st, Soho, London, W.C.

Berry (F. H.) & Co, Electrical Instrument Makers, 14A, Clerkenwell-green, London, E.C.

Berry (W. D.) & Son, Electrical Apparatus Makers, Telephone Contractors, &c., Faraday Works, Brook-st, Huddersfield

Berry (Z. D.) & Sons, Electric Apparatus Makers, 16, Regency-st, Westminster, S.W., and 10, Buckingham Palace-rd, London, S.W.

Bersey, Walter C., Dealer in Electrical Supplies, 24, Little Queen-st, Westminster, London, S.W.

Bertram & Co, Electric Light Engineers, 101, Dean-st, Soho, London, W.

Bessbrook and Newry Tramway Company (Electrical), Besabrook, co. Armagh. (*Tramway Bessbrook*)
J. L. D. Meares, C.E. ...Consulting Engineer
Dr. E. Hopkinson .....Consulting Electrician
H. Harrison .....Secretary
See also pp. 159 and 275.

Bessemer, A. G., jun., Electrical Engineer, Whitehall Club, Westminster, London, S.W.

Bessemer (Henry) & Co, Limited, Manufacturers of Castings, Forgings, &c., Castle-st East, Sheffield. (*Bessemer Sheffield*)

Bessler, Waechter & Co, Metal, Chemical and General Merchants, 18 and 19, Fenchurch-st, London, E.C.; and 8 and 10, Dean-st, Newcastle-on-Tyne. (*Bessler London*)

Best & Lloyd, Electrolier Manufacturers, Cambray Works, Handsworth, Birmingham; and 10, Bartlett's-buildings, Holborn-circus, London, E.C. (*Best Birmingham, 2035*)

Best & Sons, Consulting Engineers, 47, Victoria-st, London, S.W. (*Nomico London*)

Beswick, Chas. W., Electrician, Arley, Northwich, Cheshire

Betts & Co, Limited, Tinfoil Manufacturers, Wharf-rd, City-rd, and Elthorne-rd, Upper Holloway, London, N.; and Moor Green Mills, Birmingham. (*Checkmate London*)

Beuttel, Henry, Maker of Electric Carpet Sewing Machines, 28, Stanhope-st, Euston-rd, London, N.W.

Bewick, Moreing & Co, Mining Engineers, Broad-st House, New Broad-st, London, E.C. (*2044*); Umtali, Manicaland, South Africa, and Salt Lake City, U.S.A.

Beyer, Peacock & Co, Limited, Engineers and Railway and Engineers' Tool Makers, Gorton, Manchester; and 110, Cannon-st, London, E.C. (*Loco Gorton, 255*)

Bezant, Alfred, Electrician, 22, Oxford-rd, Waterloo, Liverpool

Bezant, W. A., Electrical Engineer and Contractor, Manufacturer and Importer of Scientific and Electrical Apparatus, 12, Bath-st, Leamington. (*Bezant Leamington, 512*)

Bicester Electricity Supply Company, Limited, Market-hill, Bicester, Oxfordshire
See also page 755

Bickel, —, Electrician and Electric Bell Fitter, Crown's Hill, Greenwich, London, S.E.

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Bickle & Co, Limited, Mechanical and Electrical Engineers, Great Western Docks, Plymouth; and Carn Brea, Cornwall. (*Engineers Plymouth, 176*)

Bidwell, Guy L., Electrical Engineer, Waterhouse Electrical Manufacturing Company, Limited, 67, Southwark Bridge-rd, London, S.E.

*Bidwell, Shelford, M.A., LL.B., F.R.S., Consulting Electrician, Riverstone Lodge, Southfields, Wandsworth, London, S.W.

Biedermann, Emil, Consulting and Civil Engineer, c/o Frederick Siemens, 10, Queen Anne's-gate, London, S.W.

Bigge (D. Selby) & Co, Electrical Engineers and Contractors, 27, Mosley-st, Newcastle-on-Tyne. (*Selby Bigge Newcastle-on-Tyne*)

Bigley, T. M., A.M.I.C.E., Consulting Engineer, 19, Castle-st, Liverpool. (*Bigley Liverpool*)

Bigsby, W. T., Varnish Manufacturer, Trundley-rd, Deptford, London, S.E. (*Bigsby London*)

Bilbie, Hobson & Co, Gas Engine Makers, 5, Bombay-st, Bermondsey, S.E., and 80, Queen Victoria-st, E.C., London

Billing & Co, Limited, Art Metal Workers, Smart's-bldgs, High Holborn, London, W.C.

Billington & Newton, Manufacturers of Phosphor Bronze, Phosphor Tin, &c., Vulcan Metal Works, Longport, Staffs. (*Bronze Longport*)

Bindleys, Limited, Ironmongers and Manufacturers of Electrical Apparatus, Burton-on-Trent

Bingham, W. G., M.A., Electrical Engineer, Electric Construction Company, Limited, Queen-street-chambers, Queen-st, London, E.C., and Wolverhampton; and 29, Notting-hill-ter, London, W.

BINKO (H.) & CO, Electrical Engineers (Sole Contractors to the London County Council for the whole Metropolitan Fire Brigade), 34, Leadenhall-st, London, E.C. (*Galvanometer London, 11196*)

Binks Bros, Lightning Conductor Makers, Strafford-st, Millwall, London, E. (*Binks London*)

Binney & Son, Makers of Driving Bands, &c., Catherine-st, City-rd, and 62, Queen Victoria-st, London, E.C.; and at Birmingham, Leeds, and Glasgow. (*Lubricative London; Lubricative Birmingham*)

Binns & Co, Wire Manufacturers, 4, Redcross-st, London, E.C.

Binns, J. & A., Wire Manufacturers, West Mount Works, Halifax. (*Wire Halifax, 214*)

*Binswanger, Gustav, Electrical Engineer, General Electric Company, Limited, 71, Queen Victoria-st, London, E.C. (*Electricity London, 1887*)

Binswanger, Max, Electrical Engineer, General Electric Company, 71, Queen Victoria-st, London, E.C.

Birch, Herbert Hy., Electrician, 15, Basuto-rd, Fulham, London, S.W.

Birch (J.) & Co, Limited, Manganese Merchants, 40, Chapel-st, Liverpool; and 10 and 11, Queen-st-place, London, E.C. (*Poolbirch Liverpool; Endeavour London, 1601*)

Bird, Thomas, Mechanical Engineer and Electrician, 21, Broughton-drive, Cressington, Liverpool

Birkbeck Literary and Scientific Institution, Bream's-bldgs, Chancery-lane, London, E.C.

Rev. W. Martin ..... { Chairman of Education Committee.

F. E. Boughton ..... { Professor of Experimental Physics

Birmingham Battery and Metal Company, Brass and Copper Tube Manufacturers, Digbeth Works, Birmingham; and 21, Gresham-house, London, E.C. (*Battery Birmingham*)

Birmingham Central Tramways Company, Limited, 119, Colemore-row, Birmingham

J. Ebbsmith ... ... Chairman
W. Holmden ... ... Secretary

See also page 275

Birmingham Electric Supply Company Limited, 14, Dale End, Birmingham. (*Dynamo Birmingham*)

H. Buckley... ... ... Chairman
John C. Vaudrey ... Managing Director
Carto Davis ... ... Secretary

See also page 276

Birmingham House-to-House Electricity Company, Limited, care of Messrs. Baker & Gibson, 39, Bennett's-hill, Birmingham. (A. H. Gibson, Secretary)

See also page 276

Birmingham Small Arms and Metal Company, Limited, Wire Drawers and Manufacturers, Armoury-rd, Smallheath, and Adderley Park Mills, Birmingham; and 5 and 6, Great Winchester-st, London, E.C. (H. Wallis, Sec.)

Birmingham Street Lamp Company, Makers of Street Lamps and Lanterns for Electric Lighting, 303, Broad-st, Birmingham. (Alfred M. Wade, Manager)

Birmingham Telegraph Factory, Limited—*in liquidation*. (James Rhodes, C.A., Waterloo-st., Birmingham, Liquidator)

Birney, W. R., Consulting Electrician, Laurel House, Kingsley Park-ter, Northampton

Birt (W. R.) & Co., India Rubber Manufacturers, 13, Westmoreland-st, Dublin

Birtley Iron Company, Engineers, Casting and Forging Manufacturers, Birtley, Durham

Bischoff, G., Analytical Chemist, 4, Hart-st, Bloomsbury, London, W.C.

Bishop, Howard W., Electrical Engineer, 2, Sutton-rd, Walsall. (*Straps Walsall*).

Bishop, W. J., Electrician, 74, George-st, Croydon

Bishop's Cluster Company, Limited, Dealers in Porcelain and China for Electrical Purposes, 147, Aldersgate-st, London, E.C. (*Cluster London*)

Bissett, J. D., Consulting Engineer, 11, Leadenhall-st, London, E.C. (*Bissett Africa House London*)

Black, Hawthorn & Co, Limited, Mechanical and Electrical Engineers, Quarry Fields, Gateshead-on-Tyne (*Blackthorn Newcastle-tyne*)

Black, Thomas, Glassblower, 116 and 117, Great Saffron-hill, London, E.C.

Blackadder Bros., Electrical and General Engineers, Garrison Foundry and Engine Works, Falkirk

Blackburn, A. B., M.Inst.C.E., Electrical Department (Messrs. Mather & Platt, Limited), Salford, Manchester

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Blackburn, Joseph, Electrical Engineer, Contractor for the Erection of Lightning Conductors, Gresham Works, Nottingham; and 2, Norfolk-st., Strand, London, W.C. (*Blackburn Nottingham, 238*)

BLACKBURN, R. S., Electrician and Contractor for Telephones, Electric Light, &c., 2, Hollins-crescent, and Hangingroyd-lane, Hebden Bridge, Yorks.

Blackham, Wm. P., Electrician, 275, Granville-rd, Sheffield

BLACKMAN VENTILATING COMPANY, Limited, Ventilating and Warming Engineers, 63, Fore-st, London, E.C. (M. Shillito, Managing Director). And at Manchester, Bradford, Glasgow, Bristol, Birmingham, and Belfast (*Ventilator London, 532; Drier Manchester, 860; Blackman Bradford, 1090; Blackman Glasgow; Blackman Bristol; Blackman Belfast, 786*)

See also page 276

Blackwall Galvanised Iron Company, Limited, Galvanisers, 4, Corbet-ct, Gracechurch-st, London, E.C. (*Promptitude London, 11064*); and Orchard-place, Blackwall (*Silverine London, 5003*)

Blackwell (George G.), Sons & Co., Manganese Producers and Carbon Makers, 25 to 27, Irwell-chambers, Fazakerly-st (*959*), and (Works) Garston (*2750*), Liverpool; and 4, Billiter-bldgs, London, E.C. (*Blackwell Liverpool*)

BLACKWELL, ROBERT W., Electrical Engineer, 39, Victoria-st, London, S.W. (*Kurkee, London, 3191*) **See Advt., p. 525**

Bladen & Co, Representatives of Messrs. C. A. Parsons & Co, 70, Wellington-st, Glasgow. (*Bladens Glasgow*)

Blagburn (Charles) & Co, Consulting Engineers, 50, Side, Newcastle-on-Tyne. (*Volatile London*)

Blaiberg & Marson, Limited, Tube Cutters, &c., Bute Works, Oozells-st, Birmingham. (*Blaiberg and Marson Birmingham*)

Blaine, R. G., A.M.I.C.E., Consulting Engineer, 2, Addison-rd, Wanstead, London, E.

Blaikie, John R., Electrical Engineer, Electric Light Works, St. James-st, Taunton

Blake, A., Electrical Engineer, Fareham Electric Light Company, Fareham, Hants

Blake, H. W., Electrical Engineer to the Derry Corporation, Town Hall, and Shipquay-st., Londonderry

Blake & Knowles' Steam Pump Works, Limited, Makers of Steam Pumps, Winchester House, Old Broad-st, London, E.C. (E. T. Gregory, Secretary)

Blake, Sydney H., Electrical Engineer, 2, Lower Ashgrove, Little Horton, Bradford, Yorks.

Blakeborough (J.) & Sons, Hydraulic Engineers, Woodhouse Iron and Brass Works, Brighouse. (*Blakeboroughs Brighouse*)

Blakeney, W. Hamilton, Electrical Engineer, Eden-grove, Dundee

Blakesley, T. H., M.A., 3, Elliot-hill, Lewisham, London, S.E.

Blakey, Edwin, M.I.E.E., Consulting Engineer and Electrician, 21, Tanfield-chmbrs, Hustlergate, Bradford

Blakey, Emmott & Co, Limited—*in liquidation*. (James Lakeman, 30, St. Swithin's-lane, London, E.C., and Bond-st., Leeds, Liquidator)

Blanchard, Geo. B., Electric Light Engineer and Contractor, 15, Whitefriargate, and Posterngate, Hull

Blenheim (W.) & Co, Manufacturers and Patentees of Electric Telephones, Bells, and General Apparatus, Egham, Surrey. (*Blenheim Egham*)

Blenkarn, Walter, Electrical Engineer, Representative for the Electrical Department, Messrs. Winfields, Limited, 49, Farringdon-st, London, E.C.

Blockley Electric Lighting and Manufacturing Company, Limited, Electrical Engineers, Astral Works, Blockley, Worcestershire. (Chas. Barter and H. N. Warburton, Managing Directors) (*Astral Blockley*)

See also page 276

Bloomfield, L. H., Electrical Engineer and Agent, 11, Queen Victoria-st, London, E.C. (*Prismatic London*)

Blount, Bertram, F.I.C., F.C.S., Consulting Chemist, 1, Broadway, Westminster, London, S.W. (*3117*)

Bloxam, T. W., Electrician, 36, Park-pl, Bayswater, London, W.

Blumann & Stern, Limited, Refiners and Importers of Lubricating Oils, Greases and Tallows, Batoum Wharf, Odessa-st., Rotherhithe, S.E. (*8092*), and 43, London-wall, E.C. (*5780*), London (*Blumann London*)

Blundell, J. Wagstaff, Electrician, 12, Delahay-st, Westminster, London, S.W.

Blundell, Spence & Co, Limited, Lubricating Oil Manufacturers, Anchor Wharf, 9, Upper Thames-st, London, E.C.; and Beverley-rd, Hull. (*Blunspence London, 1624; Blundells Hull, 1858*)

Blundell's London Copper and Brass Works, Limited, 23 and 25, West India Dock-rd, London, E. (H. V. Geary, Secretary.) (*Blundell London, 5029*)

Blundell, John, Gold and Silver Smelter, Refiner, and Assayer, 162, Wardour-st, London, W.

Blundstone, Samuel Richardson, Consulting Engineer, 8, Catherine-st, Strand, London, W.C.

Blyth, Prof. James, M.A., F.R.S.E., Consulting Electrician, Anderson's College, Glasgow

Blyth & Pascoe, Timber Merchants, Phœnix Saw Mills, Dewberry-st., Bromley, E., and 8, London-st, E.C., London (*Blyth-Pascoe London, 5072*)

Blythe, H. O., Electrician, 3, Eliot-hill, Lewisham, London, S.E.

Boake (A.), Roberts & Co, Sulphurous Acid Manufacturers, Stratford, London, E.

Boam, Frederick W., F.C.S., F.G.S., Analytical Chemist and Assayer, The Laboratory, 35, Silver-st, Leicester. (*Quotations Leicester, 399*)

BOARD OF TRADE, Whitehall-gdns, London, S.W. (*For Officials, see page 230*)

BOARD OF TRADE REGULATIONS—*see pp. 112 to 119*

Board of Trade Electrical Standards Laboratory, 8, Richmond-ter, Whitehall, London, S.W. (John Rennie, M.I.E.E., Electrical Engineer)

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Boardman's Electric Sun Lamp Patents, Ltd., Electricians, 238, Tottenham Court-rd, W., and 74, Hampstead-road, N.W., London

Boby, William, Mechanical Engineer, 16, Union-court, Old Broad-st, London, E.C.

Boden, H. O., Manufacturer of Dynamo Castings, Walmer-pl, Old Trafford, Manchester

Bodill, Parker and Co, Limited, Brass and Iron Founders, Albion Works, Great Hampton-row, Birmingham (*Bodills Birmingham, 4160*)

Böhm (Ernest) & Co, Limited, Electricians and Makers of Globes for Arc and Incandescent Lamps, 32, Gray's Inn-rd., London, W.C.

Boiler Insurance and Steam Power Company, Limited, 67, King-st, Manchester; and at Glasgow and London. (*Boiler Manchester, 1188; Truth Glasgow; Boiler London*)

Bolas, T., F.C.S., F.I.C., &c., Consulting Chemist and Electrician, Electrical, Chemical, and Physical Laboratories, 60, Grove Park-ter, Chiswick, London, W. (*Bolas London*)

Bolding (John) & Sons, Manufacturers of Electric Light Fittings, &c., Grosvenor Works, Davies-street, W., and 298, Euston-road, N.W., London

Boldron, T., Commission Merchant and Dealer in Electrical Supplies, 21, Stackpool-rd, Bristol

Bole Hall Mill Company, Tape Manufacturers, Tamworth

Bolling & Lowe, Manufacturers' Agents, 2, Laurence Pountney-hill, London, E.C. (*Bird London, 1530*)

Bolton, Alfred S., Electrical Engineer, Moor-ct, Cheadle, Staffs

Bolton Electrical Engineering Company, Electrical Engineers, corner Bradshawgate and Deansgate, Bolton

Bolton Engineering Company, Tool Makers, Hydraulic and Electric Crane Builders, Turton-st, Bolton. (*Bec Bolton*)

Bolton Iron and Steel Company, Limited, Manufacturers of Castings, Bolton-le-Moors, Lancs; and 38, Parliament-street, London, S.W. (*Hammer Bolton, 161; Weldable London*)

Bolton, John, Electrical Engineer, 15, Tresco-rd, Linden-grove, Nunhead, London, S.E.

Bolton (R.) & Co, Limited, 110, Leadenhall-st, London, E.C.

Bolton (T.) & Sons, High-Conductivity Copper Wire Manufacturers, Mersey Copper Works, Widnes; Broad-st Metal Works, Birmingham; and Cheadle, Staffs. (*Boltons Birmingham; Rolls Widnes*)

Bolton & Sons, Electricians, 47, West Nile-st, Glasgow. (*Gresham Glasgow*)

Bolton, W., Superintendent Eastern Telegraph Company, K13, Exchange-bldgs, Liverpool

Bond (J.) & Son, Electric Light Apparatus Makers, Bond's Wharf, 44, Orchard-pl, Blackwall, London, E.

BONNELLA (D. H.) & SON, Ivory and Hard Wood Turners for Electrical Purposes, 58, Mortimer-st, W., and 42 and 43, Kirby-st, Hatton-gdn, London, E.C. **See Advt., p. 647**

Bonney, G. E., Electro-Metallurgist, 5, Ravensbourne-ter, Morden Hill, Lewisham, London, S.E.

Bonney, S. R., Electrician and Electro-Plater, 25, Avenue-rd, Lewisham, London, S.E.

Bonsor, W. V., Electrical Engineer, Madame Tussaud's, Baker-st, London, W.

Boome, George F., Manufacturing Chemist, Star Chemical Works, Bow Common, London, E.

BOOR (G.) & CO, Chemical Manufacturers, 1 and 2, Artillery-lane, Bishopsgate-st, London, E.C. (*Boor London, 1488*) **See Advt., p. 440**

Booth (George) & Co, Machine Tool Makers, Central Iron Works, Halifax. (*Booths Engineers Halifax*)

Booth, Henry, Electrician, 80, Linnæus-st, Hull

Booth (James) & Co, Brass and Copper Tube Makers, Sheepcote Street Tube and Rolling Mills, Birmingham

Booth (Joseph) & Bros, Engineers, Crane and Lift Manufacturers, Rodley, Leeds; and 9, Ducksfoot-lane, Cannon-st, London, E.C. (*Cranes Rodley, 2020*)

Booth, William H., Electrical Engineer, Westminster Electric Supply Corporation, Limited, Eccleston-pl, London, S.W.

Boothby & Watson, Consulting Engineers, 2, Old Palace-yard, Westminster, London, S.W.

Bordley & Co, Limited, Electro Platers, &c., 39½, Leather-lane, London, E.C.

Borland, F. J., Engineer and Electrician, 2, Sheepscar-grove, Benson-st, Leeds

Borns, H., PhD., F.C.S., Technical Translator, 19, Alexandra-rd, Wimbledon, Surrey

Borough Polytechnic Institute, 103, Borough-rd, London, S.E.

W. M. Richardson... ... Secretary

C. T. Millis, M.I.M.E. } Principal of Educational Department

Borthwick, J. F., Electrical Engineer, 102, Hope-st, Glasgow

Borton, Henry, Zinc Merchant, 316 and 318, Bethnal Green-rd, London, E.; and 130, High-st, Ramsgate. (*Bortonius London, 35a*)

Bosanquet, Charles J., Electrical Engineer, 73, Queen Victoria-st, London, E.C.; and Ripley Lodge, Belvedere, Kent. (*Dynomene London*)

Bösch, Adolph, Wire Manufacturer, 14, Rope-maker-st, Finsbury, London, E.C.

Bosher (A. B.) & Co., Cast Steel Manufacturers, Carbon Works, St. George's-sq, Sheffield

Bosshardt & Wilson Company, Lubricating Oil Manufacturers, 13A, Eastcheap, London, E.C.; and at Liverpool. (*Lucid London*)

Bostel (D. T.) & Son, Engineers and Electricians, 73, Ebury-st, London, S.W.

Botham, Arthur, Electrical Engineer, 47, Romilly-rd, Finsbury Park, London, N.

Botten, Hy, Electrical Apparatus Manufacturer, 39, Lime-st, London, E.C.

Botting, Francis, Electric Bell Fitter, 6, Baker-st, London, W.

Botting (James) & Co. Manufacturing Electricians, 30, Berners-st, Leicester

*Bottomley, J. T., M.A., D.Sc., F.R.S., F.R.S.E., F.C.S., Consulting Electrical Engineer, The University, and 13, University-gardens, Glasgow. (*2055*)

Bottomley & Liddle, Patent Agents, 154, St. Vincent-st, Glasgow. (*Patentable Glasgow, 1227*)

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Bottomley, William, Electrical Engineer, 15, University-gdns, Hillhead, Glasgow

Bottone, S. R., Electrician, Wallington, Surrey. (*Bottone Wallington*)

Boucher, —, Electrician, Manager of Dublin Branch of the Edison & Swan United Electric Light Co, Ltd, Dawson-st, Dublin

BOUDEWIJNSE, JOHAN, Incandescent Lamp Maker, Middelburg, Holland. **See Advt.**, p. 15, *and* CONTINENTAL DIVISION.

Boudreaux Dynamo Brush Company, Makers of the Boudreaux Dynamo Brush, St. Martin's House, 1, Gresham-st, London, E.C. (*See also* CONTINENTAL DIVISION.)

Boughton, Frederick E., Professor of Physics at the Birkbeck Literary and Scientific Institution, Bream's-bldgs, London, W.C.

Boult Bros. & Co. Lubricant Manufacturers, 62, Dale-street, Liverpool; and 38A, King William-st, London, E.C. (*Valvoline London*)

Boult, W. S., A.M.I.C.E., Electrical Engineer, Bank-bldgs, 60, Castle-st, Liverpool. (Mr. Boult is the compiler of the "Comprehensive International Wire Table.")

Boulter, C. A., Electrical and Mathematical Instrument Maker, 7½, St. John's-lane, Clerkenwell, London, E.C.

Boulting, John, Electric Bell Fitter, 5 and 6, Upper Marylebone-st, W,

Boulting, Thomas John, Electric Light Engineer, 16 and 17, Union-st, Middlesex Hospital, London, W.

Bourn, H., Electrician, Baythorn End, Halstead, Essex

Bourne & Grant Electricity Supply Company, Limited, 15, George-st, Mansion House, London, E.C. (R. G. H. Atkins, Secretary)
See also page 276

Bourne & Grant, Electric Light and Power Contractors, 15, George-st, Mansion House, London, E.C. (*Periodicity London*)

BOURNE (JOSEPH) & SON, Manufacturers of Telegraph Insulators, Battery Jars, and Porous Cells, New St. Pancras Station, Euston-rd, London, N.W.; and Denby Pottery, near Derby. (*Danesby London, 7516*) **See Advt., p. 580**

Bourne, W. F., Electrical Engineer, 41, Priory-rd, Bedford Park, Chiswick, London, W.

Bournemouth and District Electric Supply Company, Limited, Observer-chmbrs, Albert-rd, Bournemouth (*Electric Bournemouth*)

A. H. Sanderson ... ... Chairman
John Rance, jun. ... ... Superintending Engineer
Charles Offer ... ... Secretary

See also page 276

Bournemouth Science, Art, and Technical School, Poole Hill, Bournemouth. (W. Woodhouse, Teacher of Electricity and Magnetism)

Bousfield, G. W., Electrician, 2, Zetland-ter, Lansdowne-rd, Old Charlton, Kent

Bousquet, Isaac, Tinfoil Manufacturer, 28, Barbican, London, E.C.

Bow and Bromley Institute, Railway Station, Bow-rd, London, E. (H. W. Parr, Secretary)

Bowden, H. W., Chief Engineer, House-to-House Electric Light Supply Company, Richmond-rd, Brompton, S.W., and 17, Ashchurch Park Villas, Ravenscourt Park, W., London

Bowden, John, Glass Bender, 44, High-st, St. Giles's, London, W.C.

Bowen & Co, Brass and Soft Iron Founders for Electricians, 6, Mount-pleasant, Clerkenwell, London, E.C.

Bowen, Kerbey, Limited, Electric Launch Builders, 55, Regent-st, London, W.; and at Ray Mead Works, Maidenhead. (*Electric Maidenhead*)

Bowen, K. D., Electrical Engineer, 55, Regent-st, London, W.; and at Maidenhead

Bower, W. R., A.R.S.M., Lecturer on Electricity, Municipal School of Science and Art, Grand Parade, Brighton

Bowerman Bros, Electrical Engineers, 35, Osborne-rd, Southsea

Bowes, Alfred, Mica and Spelter Merchant, Wild's Rents, 174, Weston-st, Bermondsey, London, S.E. (*Remelted London*)

Bowes Scott & Western, Mining Machinery Engineers, Broadway-chmbrs, Westminster, London, S.W. (*Donbowes London, 3199*)

Bowker Bros, Electrical and Mechanical Engineers, 270, St. Paul's-rd, Preston

Bowker (William) & Co, Electrical Engineers, 43, Grove-st, and 4, Spring-st, Huddersfield

Bowles, E. Wingfield, Electrical Engineer, 28, Victoria-st, London, S.W.

Bowling Iron Company, Limited, Boiler Makers and General Engineers, Bradford; and 7A, Laurence Pountney-hill, London, E.C. (*Bowling Bradford*)

Bowman, C., Engraver in Brass, &c., 6, King-st, Tower-hill, London, E.C.

Bowman, E. K., Sanitary Engineer and Electric Bell Fitter, 8, Wynford-rd, London, N.

Bowman, Dr. F. H., F.R.S.E., Consulting Electrical Engineer, Bowdon, Cheshire

Bowman, John J., Electrical Engineer, Craigendarroch, Skelmorlie, Ayrshire

Bowron, G., Electrician, Electrical Apparatus Maker, 93, Praed-st, London, W.

Box (Edward) & Co, Limited, Engineers and Contractors, 14, North John-st., Liverpool; and Esk-street, Derby-rd, Bootle, Lancs.

Box (W. R.) & Co, Brass Founders, Electro-Platers and Dynamo Makers, 105, Middle Abbey-st, Dublin

Boy Messengers and Electric Call Company, Limited—*amalgamated with the* District Messenger Service and News Co. (*q.v.*)

Boyd (Alex.) & Son, Engineers and Electric Bell Fitters, 105, New Bond-st, London, W.

Boyd, R., Electrical Engineer-in-Charge, Craigside Hydro, Llandudno

Boydell, Thomas, Electrical Engineer and Electro Plater, Elswick Court, Newcastle-on-Tyne

Boyden, Thomas, Electrical Engineer, 129, Old Dover-rd, Blackheath, London, S.E.

Boyle, Robert Kirk, Electrician, 106, Clapham-rd, London, S.W.

Boyle (Robert) & Son, Limited, Ventilating and Consulting Engineers, 110, Bothwell-st, Glasgow; and 64, Holborn-via, London, E.C.

*Boys, C. Vernon, A.R.S.M., F.R.S., Royal College of Science, Exhibition-rd, South Kensington, London, S.W.

Bozon, R. S., Electric Light Engineer, General Post Office, Birmingham

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Braby, E. & C., Manufacturers of Slate Switch Boards, Insulators, Bases, &c., Bangor Wharf, Belvedere-rd, London, S.E. (*Marble London, 4825*)

Braby (F.) & Co, Limited, Makers of Zinc Battery Plates, Zinc Rods, and Aluminium, 352 to 364, Euston-rd, N.W., 118 & 120, High-st, Borough, S.E., and 110, Cannon-st, E.C., London; 47 and 49, St. Enoch-sq, Glasgow; and Hatton-gdn, Liverpool. (*Courteous London; Braby Deptford London; Xenophon London; Braby Glasgow; Braby Liverpool*)

Bracebridge-Mills, F., Consulting Engineer, 59 and 61, Hatton-gdn, London, E.C.

Bradbury & Co, Limited, Manufacturers of Electrical and General Engineers' Lathes and Tools, &c., Wellington Works, Oldham. (*Rotary Oldham*)

Bradford (John) & Sons, Dynamo Oil Manufacturers, Liverpool. (*Lubricants Liverpool*)

Bradford Technical College, Bradford. (*For List of Professors see page 272*)

Bradley & Burch, Metal Merchants, Leadenhall-bldgs, London, E.C.

Bradley & Co, Galvanisers and Stampers, Albion Works, Bilston, Staffs. (*Galvanic Bilston, 7525*)

Brady and Martin, Electrical and Scientific Apparatus Makers, Northumberland-rd; and 29, Mosley-st, Newcastle-upon-Tyne

Braham, A. & E., Engravers on Wood, &c., 181, Queen Victoria-st, London, E.C.

Braid, H. R., Electrical Engineer, Grove Park-gdns, Chiswick

Brain, C. T. B., Electrical Engineer, 32, Garmoyle-rd, Liverpool

Brain, Frank, Mining and Electrical Engineer, Trafalgar House, Drybrook, Gloucester. (*Trafalgar Serridge Junction*)

Braithwaite, A., Dealer in Electrical Supplies, 37, Palace-ter, Fulham, London, S.W.

Braithwaite (Isaac) & Son, Merchants and Engineers, Kendal; and 24, Garlick Hill, Cannon-st, London, E.C.

Braithwaite, Joseph Bevan, jun, M.I.E.E., Chairman of the Brush Electrical Engineering Company, Limited, and Director of the City of London Electric Lighting Company, Limited, 27, Austin-friars, London, E.C.

Braithwaite & Kirk, Engineers, Crown Bridge Works, West Bromwich; and 12, Dartmouth-st, Westminster, London, S.W. (*Braithwaite West Bromwich*)

Brampton (F.) & Co, Metal Stampers and Piercers, Oliver-street Works, Birmingham. (*Brampton Birmingham, 585*)

Bramwell, Sir Frederick, Bart., D.C.L., LL.D., F.R.S., M.I.E.E., Consulting Electrical Engineer, &c., 5, Great George-st, London, S.W. (*Wellbram London, 3060*)

Bramwell & Harris, Consulting Engineers, 5, Great George-st, London, S.W. (*Wellbram London, 3060*)

Brandreth, W. E., Electrician, 9, Spring-bank, Preston

Bransgrove, E., Electric Bell Fitter, 144, Walton-st, London, S.W.

Brantingham, J. B. and W. P., Electrical Engineers, 4, Norfolk-st, Sunderland; and at Houghton-le-Spring

Braulik, George, Electrical Engineer, 217 & 218, Upper Thames-street, London, E.C.

Braun, H. C., Engineer and Electrician, 118, Viaduct, London, E.C. (*Accessories London*)

Brawn (Thos.) & Co, Makers of Electric Light Fittings, 64, Clement-st, Birmingham

Bray, James, Electrician, 17, Thomas-st, Landport

Brayne (Francis) & Co, Earthenware Manufacturers for Electrical Purposes, Bow Pottery, Three Mills-lane, St. Leonard-st, Bromley-by-Bow, London, E.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY, Limited, Winchester House, Old Broad-st, London, E.C. (*Amulet London*)

Sir John Pender, G.C.M.G., M.P. Chairman
Thomas Fuller ... ... Man. Director
Richard Collett ... ... Secretary

See also page 276

Breadner, E., Engineer and Turbine Maker, 134, Deansgate, Manchester

Brebner, Alexander, M.I.C.E., Consulting Engineer, 68, Victoria-st, London, S.W. (*Eclatant London*)

Brebner, R. C., Consulting Electrical Engineer, 5, Morningside-drive, Edinburgh

Breece, A., Electrical Engineer, 22, Goswell-rd, London, E.C. (*Breese London, 899*)

Breeden (Joseph) & Co, Limited, Makers of Electric Light Fittings, New Mill Works, Fazeley-st, Birmingham

Breeze & Paterson, Manufacturing Electricians, 109, Bath-st, Glasgow

Breffit (Edgar) & Co, Chemical Apparatus Makers, 83, Upper Thames-st, London, E.C. (*Breffits London, 1845*)

Bremner (John A.) & Co, Manufacturers of Lubricating Oils, Albert-st, Manchester; and 72, Mark-lane, London, E.C. (*Roman Manchester*)

Brent (G.) & Son, Coppersmiths and Braziers, 45, Upper East Smithfield, and 94, West India Dock-rd, London, E.

Brett (E.) & Co, Electric Light Silk and Lace Shade Manufacturers, 31, Foley-st, London, W.

Brettell & Needham, Limited, Manufacturing Engineers, Shrub Hill, Worcester

Brew, William, Electrician, Electric Light Depôt, British Museum, London, W.C.

Brewer & Son, Patent Agents, 33, Chancery-lane, London, W.C. (*Infallible London*)

Brewer, W. J., Electrician, 7, John-st, Bedford-row, London, W.C.

Brewster, E. H. G., A.M.I.C.E., M.I.M.E., Consulting Engineer and Patent Agent, 12, Delahay-st, Westminster, London, S.W.

Brewtnall, A. W., Electrician, 4, Cateaton-st, Manchester

Bridges, T. H., Consulting Engineer, 138, Leadenhall st, London, E.C. (*4041*)

Bridson, E. Ridgway, M.A., Electrician, Field House, Summertown, Oxford

Briggs. Alex. M., Jun., Electrician, 1A, Hoghton-st, Southport

Briggs, W. Archibald, Maker of Aluminium Alloys, 87, High-st, Dundee

***Bright,** Chas., F.R.A.S., F.R.G.S., A.M.Inst.C.E., M.I.E.E., Telegraph Works, Silvertown, Essex

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Brighton and Hove Electric Light Company, Limited, 46 and 48, Gloucester-rd, Brighton. (W. Spencer Hawes, Secretary). (*Business acquired by the Brighton Corporation*)
See also page 276.

Brighton & Rottingdean Seashore Electric Tramroad Company, Madeira-rd, Brighton (Magnus Volk, Manager)
See also page 276.

Brinjes & Goodwin, General Engineers, 25, Fieldgate-st, London, E. (*Brinjes Goodwin London*)

BRISTOL ELECTRIC SAFETY LAMP WORKS, Makers of Portable Electric Safety Lamps and Accumulators, 63, Queen Victoria-st, E.C., and (Works) 40, Great Smith-st, Westminster, S.W. London. **See Advt., p. 601**

Bristöl, L., Manufacturing Electrician, Bristol Electric Safety Lamp Works, 40, Great Smith-st, Westminster, London, S.W.

Bristow (Samuel Clay) & Co, Paraffin Wax Manufacturers, 21, Great St. Helens, London, E.C.

Bristowe (L. Hugh) & Co, Engineers and Makers of the "Riddell" Filter and "Carrod" Water Softener, Albany-bldgs, 47, Victoria-st, London, S.W. (*Fotiosus London*)

Britannia Company, Makers of Lathes and Tools for Electricians, Petroleum Oil Engines, &c., Britannia Tool Factory, Colchester; and 100, Houndsditch, London, E. (*Britannia Colchester*)

Britannia Rubber and Kamptulicon Company, Vulcanite and Ebonite Manufacturers, 32, Cannon-st, 86, Queen Victoria-st, E.C., and (Works) Bow, E., London. (*Britannia London*)

British and Colonial Mica Company, Mica Merchants and Importers, 11, Wardrobe-pl, Queen Victoria-st, London, E.C.

British Asbestos Company, Asbestos Merchants, 16, Duke-st, Aldgate, London, E.C. (*Amiante London*)

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, Burlington House, London, W. (1894 Meeting in Oxford, Aug. 8th)

Dr. Burdon Sanderson, F.R.S. President
Marq. of Salisbury, K.G. ... President-Elect
Sir Douglas Galton, K.C.B. } Gen. Secretaries
A. G. Vernon Harcourt, F.R.S. }
G. Griffith, M.A. ... ... Assist. Gen. Sec.

BRITISH ELECTRIC LIGHT COMPANY, THE, Limited, 11, Delahay-st, Westminster, London, S.W. (Chas. S. Bingley, Secretary) (*Turnecocks London, 3049*) **See Advt., p. 49**
See also page 276

British Electric Tramways and General Syndicate, Limited, 81, Gracechurch-st, London, E.C.
See also page 277

British Electro-Chemical Agency, Limited, Manufacturers of Electrical and Electro-Chemical Apparatus, &c., 16, Gt. George-st Westminster, London, S.W. (M. W. J. Caulfield, Secretary)
See also page 277

British, Foreign and Colonial Patents Syndicate, Limited, Patent Agents and Brokers, 15, George-st, Mansion House, London, E.C.

BRITISH GOVERNMENT DEPARTMENTS, and the Chief Officials connected with Electricity, Engineering, &c.—*see pp. 230 to 233*

British Insulated Wire Company, Limited, Prescot, Lancs. (*Insulator Prescot, 108*)
See also page 277.

British Iron Trades' Association, 29, Great George-st, London, S.W. (Wm. Jacks, M.P., President; J. Stephen Jeans, Secretary)

British Metal Expansion Company, Limited, Stanton Works, West Hartlepool; and 3, Lambeth-hill, Queen Victoria-st, London, E.C. (*Expansion West Hartlepool*)

British Seamless Steel Tube Company, Limited, Patent Tube Manufacturers, Smethwick Works, near Birmingham. (*British Birmingham, 2038*)

British Steam Generator and Refuse Utilisation Co, Limited, Halifax

British Tanning Company, Limited (Electric)—*in liquidation*. (John Dalgleish, C.A., 8, Old Jewry, London, E.C., Liquidator)

British Telegraph Manufactory (Geo. Driver, Proprietor), Telegraph Instrument Makers, 210, Euston-rd, London, N.W.

British Trade Journal (English monthly, Spanish alternate months), 113, Cannon-st, London, E.C. (*British Trade Journal London, 1966*)

British Trade Protection Office, Monument-chmbrs, King William-st, London, E.C. (R. W. Barker, Manager.) (*Fabrique London*)

British Volta Electric Glow Lamp Company, Limited, Incandescent Lamp Manufacturers, 49, Queen Victoria-st, London, E.C. (E. C. Morgan Heath, Secretary)
See also page 277.

Brittan, Thomas, Telegraph Engineer and Contractor, 21, Hermes-st, Pentonville-rd, London, N.

Britten, W. A., Electrician, 17, Red Lion-st, Clerkenwell, London, E.C.

Brittle, John Richard, M.Inst.C.E., F.R.S.E., Telegraph Engineer, 9, Vanbrugh-hill, Blackheath, London, S.E.

Britton, R., Assist.-Supt., Postal Telegraph Factory, Bovay-pl, Holloway, London, N.

Broadbent, Frank, Electrical Engineer (Messrs. J. H. Holmes and Co), 17, Portland-rd, Newcastle upon-Tyne

Broadbent (Thos.) & Sons, Engineers and Electric Crane Builders, Central Iron Works, Chapel Hill, Huddersfield. (*Broadbent Huddersfield, 102*)

Broadhurst, B., Secretary Brush Electrical Engineering Company, Limited, &c., 49, Queen Victoria-street, London, E.C.; and Minerva-road, Kingston-on-Thames. (*1910*)

Brockie, James, Electrical Engineer, Messrs. Johnson & Phillips, Victoria Works, Charlton, Kent; and 12, Tyson-rd, Forest Hill, London, S.E

Brockman (E.) & Co, Manufacturers of Paraffin Wax, 23, St. Mary-axe, London, E.C.

Brodie, Colin, A.I.E.E., Private Wire Department, Secretary's Office, G.P.O., St. Martins-le-Grand, London, E.C.

Brodrick, Hon. A., Secretary to the Submarine Cables Trust, Winchester House, Old Broad-st, London, E.C.

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Broekman, Louis, Electrical Engineer, Manager Epstein Electric Accumulator Company, Limited, 21A, Blythe-rd, Hammersmith, London, W.

Bromhead, S. S., C.E., Patent Agent, 97, Newgate-st, London, E.C.

Bromley, Walter Jas., Electrical Engineer, 124, Kilburn-lane, Kensal Green, London, N.W.

Brooke (Joseph) & Co, Electric Organ Builders, Victoria-rd, Glasgow

Brooke, J., Electrician and Electric Bell Fitter, 9, Cross-st, Wakefield

Brooke, J. W., Engineer and Maker of Lifts, Hoists, &c., Adrian Ironworks, Lowestoft

Brooker, A., Instructor in Electrical Engineering at the Telegraphists' School of Science, St. Martins-le-Grand, London, E.C. (*See also* Slingo & Brooker)

Brooker, Dore & Co, Metal Merchants, 4, Corbet-ct, Gracechurch-st, London, E.C. (*Brooker London, 11064*)

Brookes & Co, Limited, Wire Workers and Weavers, 4, Cateaton-st, Manchester; and Springfield Wire Works, Salford

Brookes (Wm.) & Son, Patent Agents, 55 and 56, Chancery-lane, London, W.C. (*Aniline London*)

Brookman, F. W., Electrician, Sanitary Manure Works, Entwistle-rd, Rochdale

Brooks, Albert, Electrical Engineer, 15, Grove-rd, Surbiton

Brooks, A. R., Electrician, Messrs. Siemens Bros. & Co, Ltd, Woolwich, Kent

Brooks, E. E., Electrician and Instructor in Electrical Engineering at the Technical School, Leicester

Brooks, S. H., Electrician, Union Iron Works, West Gorton; and Slade House, Levenshulme, near Manchester

Brooks (Thomas) & Co, Limited, Makers of Electroliers, Sackville-pl, Dublin

Brooks & Walker, Asbestos Merchants &c., 18, London-st, Fenchurch-st, London, E.C.

Brotherhood, Peter, Steam Engine Maker, 15 and 17, Belvedere-rd, Lambeth, London, S.E. (*Brotherhood London*)

Brotherton, John, Ld., Iron Tube Manufacturers, Imperial Tube Works, Wolverhampton; and 3, Jeffrey's-sq, St. Mary-axe, London, E.C. (*Brotherton Wolverhampton*)

Broughton Copper Company, Limited, Copper Manufacturers, Broughton Copper Works, Manchester; and 122, Cannon-st, London, E.C.; and at Glasgow. (*Copper Company Manchester, 638; Copper Company London*)

Browett & Co, Silversmiths, Electro-Plate Manufacturers, 14, Dean-st, Birmingham. (*Browett Birmingham*)

Browett, Lindley & Co, Limited, Electric Light Engine Makers, Sandon Works, Patricroft, Manchester (*Sandon Patricroft*)

Brown, A. C., Electrician, Mechanician, and Fire Alarm Expert, Single Wire Multiple Telephone Co., Ltd., 11, Old Broad-st, E.C.

Brown (A.) & Son, Steam Engine and Boiler Makers, Londonderry

Brown Bayley's Steel Works, Limited, Makers of Steel Castings for Electricians, Sheffield; and 1, Queen Victoria-st, London, E.C. (*Bayley Sheffield; Bali London*)

Brown, Bradshaw, Electrical and Mechanical Valuer, Billiter-square-bldgs, Billiter sq, E.C. (*11144*), and 173, West Ferry-rd, E., London

Brown, E. Houghton, General Engineer, Kingsbury Works, Ball's Pond, London, N. (*Spherulite London, 256*)

Brown, Frederick, Electrician to the Corporation, Fairyfield, Highgate-rd, Walsall, Staffs. (*6045, 6048*)

Brown, F. G., Electrician, North-st, Rushden

Brown, F. R., Maker of Commutators, Richmond Engineering Works, 1, Castle-yd, Richmond, Surrey

Brown, F. W., Chemical and Electrical Apparatus Maker, 25, Charlotte-st, Caledonian-rd, London, N.

Brown (G. R.) & Co, Belting Manufacturers, 41, St. Mary-axe, London, E.C. (*Flagship London*)

Brown (James A.) & Co, Electrical Engineers, 98, Great Tower-st, London, E.C.

Brown, John, Electrician, Edenderry House, Shaws Bridge, Belfast

Brown, John, Electrician, 120, Acre-lane, Oldham, Lancs.

Brown, John S., Electrical Engineer, 21 and 62, Oxford-st, Swansea

Brown, Lenox & Co, Iron Telegraph Buoy Makers, 9, Martin's-lane, Cannon-st, E.C. (*11309*), and 488, Westferry-rd, Millwall, E. (*5262*), London. (*Ambidexter London*)

Brown, Marshalls & Co, Limited, Makers of Electric Tramcars, Birmingham; and 19, Great George-st, Westminster, London, S.W.

Brown & May, Mechanical and General Engineers, Devizes; and 100B, Queen Victoria-st, London, E.C.

Brown, Oswald, M.I.C.E., Civil Engineer, 32, Victoria-st, London, S.W. (*Acqua London*)

Brown, R. Railston, Electrical Engineer to the Bridlington Local Board, Bridlington

Brown, Richard, Electrician, 43, Milner-st, Preston, Lancs.

Brown, R. T., Secretary West India and Panama Telegraph Company, Limited, Dashwood House, New Broad-st, London, E.C.

Brown, W. A. M., Electrician, 13, Ash-grove, Victoria-rd, Headingley, Leeds

Brown (W. B.) & Co, Wire and Lightning Conductor Manufacturers, Globe Works, Bankhall, Liverpool. (*Steerope London*)

Brown, —, District Superintendent of the National Telephone Company, Dundee

Browne, Arthur, Electric Light Engineer and Contractor, 20, Kensington Court-place London, W.

Browne (Chas.) & Co, Electrical Engineers, 28, Francis-st, London, W.C.

Browne, H. F., Nickel and Silver Plater, 35, Kirby-st, Hatton Garden, London, E.C.

Browne, J., Engineer and Electrician, 9, Ansdell-rd, Nunhead, London, S.E.

Browne (James) & Co, Electrical Fitters, 170 Sloane-st, London, S.W.

Browne, Newnham, Chartered Patent Agent, Old Mansion House, 73, Cheapside, London, E.C.

Browning (E. A.) & Gardner, Mechanical and Electrical Engineers, 122, George-st, Edinburgh. (*Electrophone Edinburgh*)

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Browning, J., Scientific Instrument Maker, 63, Strand, London, W.C.

Brownlee (A.) & Co, Electric Ship and Street Lamp Makers and Galvanisers, 33 and 34, Anderston Quay, Glasgow. (*3420*)

Brownlee, Walter H., A.I.E.E., City Electrical Engineer, Dudhope Crescent-rd, and 1, Blackness-crescent, Dundee

Broxburn Oil Company, Limited, Makers of Paraffin Wax, 28, Royal Exchange-sq, Glasgow; and Devonshire-chmbrs, Bishopsgate-st, London, E.C. (*Broxburn London, 418.2*)

Bruce (Alex.) & Co, Telegraph Pole Makers, 45, West Nile-st, Glasgow; Boston, Lincolnshire; Methill, Fife; and Troon, Ayrshire

*Bruce, Eric S., Electrician and Balloon Engineer, 10, Observatory-avenue, Kensington, London, W.

Bruce (R. T.) & Co, Manufacturers of Anti-Fouling and Anti-Corrosive Compositions, 5, Commercial-rd, Hull. (*Compo Hull, 295*)

Bruce & Still, Limited, Galvanised Iron Manufacturers, 77, Norfolk-st, Liverpool. (*Galvaniser Liverpool, 517*)

Brunton, Sydney Linton, Electrical Engineer, Arc Works, Chelmsford, Essex

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, Electrical and Mechanical Engineers, Makers of Electric Lamps, Dynamos, Alternators, Transformers, Steam Engines and Boilers, Tramcars, Wagons, &c. Head Offices: 49, Queen Victoria-st, London, E.C. (*Magneto London, 1910*). Offices of Superintending Engineer: 112, Belvedere-rd, Lambeth, London, S.E. (*Effulgent London, 4564*). Works: Lambeth (London), Loughborough (*Falcon Loughborough*), and Vienna

J. B. Braithwaite, jun. Chairman
John S. Raworth, R. Percy Sellon — Joint Managers
W. Geipel ... .. Superintndg. Engineer
B. Broadhurst ... Secretary

See also page 277

Bryan, Frank, Electrician, 18, Colville-ter, Chiswick, London, W.

Bryant, E. M., Electrical Engineer, 19, Wentworth-place, Newcastle on-Tyne

Bryant, George, Electrician, 51, Cricketfield-rd, Hackney Downs, London, N.E.

Bryceson Bros, Electric Organ Builders, 54, Essex-rd, London, W.

Bryden (John) & Sons, Mechanical and Electric Bell Hangers, 60, Gloucester-rd, Queen's Gate, London, S.W.; 60, Renfield-st, Glasgow; and at Edinburgh and Dundee

Bryden (Wm.) & Son, Bellhangers, Electric Light and Telephone Engineers, 300, St. Vincent-st, Glasgow (*1072*); and 55, George-st, Edinburgh (*364*)

Brymbo Steel Company, Manufacturers of Steel Castings, Brymbo, near Wrexham. (*Steel Wrexham*)

Bryson, William A., F.R.S.E., Consulting Electrical Engineer, 11, Bothwell-st, Glasgow

Buchan, Mathew, Constructing and Consulting Electrical Engineer, Waverley Electric Works, Portobello, Scotland. (*Electric Portobello*)

Buchan, W. P., Sanitary and Ventilating Engineer, 36-38, Renfrew-st, Glasgow

Buchanan, Harvey C., Electrician and Superintendent, Weybridge Electric Supply Company, Limited, Thames-st, Weybridge. (*Whardown Weybridge*)

Buchanan (Henry) & Co, Hot-Air Engine Makers, 86, Leadenhall-st, London, E.C.

Buchanan, J. A., Electrical Engineer, 41, Colville Gardens, Bayswater, London, W.

Buchanan, R. McGoune, Manager of the Mica Company, 86, Leadenhall-st, London, E.C. (*Boulanger London*)

Buck, Joseph, Lathe and Tool Maker for Electricians, 56, Holborn-viaduct, E.C., and 220, Blackfriars-rd, S.E., London

Buck & Hickman, Dealers in Machine Tools, &c., 280 and 281, Whitechapel-rd, and 1-7, Union-st, London, E. (*Roebuck London*)

Buckingham Electric Light and Power Supply Company, Buckingham. (Parr & Gillies, Engineers). (*Electric Buckingham*)

Buckley (J. M.) & Co, Electric Light Engineers, 10, Mortimer-st, and Nassau-st, London, W.

Buckley & Taylor, Makers of High-Speed Compound Electric Light Engines, Castle Ironworks, Oldham. (*Engines Oldham, 8*)

Bucknall, Arthur, Electrician, 19, Renshaw-st, Liverpool

Buckney, Thomas, F.R.A.S., Electrician, 53, Gower-st, London, W.C.

Budd, F., Electrical Engineer, c/o Messrs. Siemens Bros. and Co, Limited, 12, Queen Anne's-gate, London, S.W.

Budden, R. W., Superintendent Commercial Cable Company, Newcastle-on-Tyne

Bugden, Thomas, India Rubber Manufacturer, 74, Goswell-rd, E.C., and 8, Blackfriars-rd, S.E., London

Bull, E., Manager of the London Central School of Electrical Engineering and Land and Submarine Telegraphy, 117, Coldharbour-lane, London, S.E.

Bull, F. P., Art Metal Worker, 226½, High Holborn, London, W.C.

BULL, J. CECIL, Secretary of the City of London Electric Lighting Company, Limited, of the County of London and Brush Provincial Electric Lighting Company, Limited, and of the Electric and General Investment Company, Limited, 1 and 2, Great Winchester-st, London, E.C. (*Pontyberem London, 4290*)

Bull, John C., Consulting Engineer and Chemist Phosphor Bronze Company, Limited, Bagot-st, Birmingham

Buller, Ernest W., M.I.E.E., 49, Charlotte-rd, Birmingham

Bullers Limited, Manufacturers of Telegraph Insulators and General Telegraph Stores, 32 and 33, Queen-st, London, E.C. Works: Birmingham, Dudley, and Hanley. (*Bullers Dudley, 8003; Bullers London, 1575*)

See also page 277.

Bulling, C. E., Engineer and Manager of the Electrical Department, Maple & Co, Limited, 141-149, Tottenham Court-rd, London, W.

Bullivant & Co, Wire Cable, Wire Rope, and Lightning Conductor Makers, &c., 72 Mark-lane, E.C., and 38, West Ferry-rd, Poplar, E., London. (*Bullivants London, 2110*)

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Bulloch, Wm., Electrician, Electric Construction Company, Limited, Queen-st-chmbrs, Queen-st, London, E.C.

Bullock, Thomas A., Superintendent Eastern Telegraph Company's London Stations, 11, Old Broad-st, London, E.C. (*1258*)

Bulmer, Fred., Consulting Electrician, Ranchlea, Harrogate. (*Ranchlea Harrogate*)

BUMSTED & CHANDLER. High-Speed Engine Makers, Cannock Chase Foundry and Engine Works, Hednesford, Staffs.; and 17, Victoria-st, London, S.W. (S. H. Terry, Representative). (*Bags Hednesford*) **See Advt., p. 13**

Makers of Chandler's Patent "Silent" Engine, for Driving Dynamos direct.

*Bumsted, F. D., Messrs. Bumsted & Chandler, Cannock Chase Foundry, Hednesford, Staffs. (*Bags Hednesford*)

Buncle, James, Electrical Apparatus Maker, 7, Hope-st, Edinburgh

Burbey, Williamson & Joseph, Electrical Engineers, 92, Queen Victoria-st, E.C., and Coxson-pl, Horselydown, S.E., London. (*Installation London, 1954*)

Burch, George J., B.A., Lecturer in Chemistry and Physics, University Extension College, Reading

Burge, Warren & Ridgley, India Rubber and Vulcanite Manufacturers, 11, Clerkenwell-green, London, E.C.

Burgess & Co, Telegraph Wire Manufacturers, 18, Chapel-st, Liverpool

Burgon & Ball, Makers of Electrical Sheep Shearing Machinery, La Platt Works, Malin Bridge, Sheffield

Burley, T., Telegraph Engineer, Midland Railway, Gloucester

Burman, R. H., Manufacturer of Globes, Reflectors, &c., 10, Weaman-st, Birmingham

Burnaby (G. R.) & Co, Lubricating Oil Manufacturers, 18, Red Cross-st, Liverpool (*Burnaby Liverpool, 1758*)

Burnby (S.) & Son, Electrical Engineers, 121, Cold Harbour-lane, Denmark-hill, Camberwell, London, S.E.

Burnell & Co, Galvanised Iron Manufacturers, Galvanisers, &c., 4, Tabley-st, Liverpool; and 85, Gracechurch-st, London, E.C. (*Burnell Liverpool, 851*)

Burnett, H. R., Electrician, Scotby Vicarage, Carlisle. (*Burnett Scotby*)

Burnet (Lindsay) & Co, Engineers and Boiler Makers, Moore Park Boiler Works, and Burnet's Siding (goods), Govan, near Glasgow. (*Burnet Glasgow, 1513; Nomen London*)

Burnham, R. H., Electrician, 90, Barrington-rd, Brixton, London, S.W.

Burns, Joseph, Lightning Conductors Fitter, 27, Whitevale-st., Glasgow

BURNS, JOHN, General European Agent for the Delaware Hard Fibre Company, 15, Long-lane, London, E.C **See Advt., p. 576**

Burrell (Charles) & Sons, Limited, Engineers, St. Nicholas Works, Thetford, Norfolk. (*Burrell Thetford*)

Burroughs, Welcome & Co, Manufacturing Chemists, Snow Hill-bldgs, Holborn-viaduct, London, E.C. (*Burcome London*)

Burt, Boulton & Haywood, Creosote Manufacturers, 64, Cannon-st, London, E.C. (*1547*); and Prince Regent's Wharf, Silvertown, Essex (*5207.*) (*Burboul London*)

Burt (J. H.) & Co, Iron, Steel, and Copper Wire Makers, 143, Cannon-st, London, E.C.

Burtles, Tate & Co, Makers of Electric Light Shades, Poland-st Glass Works, Oldham-rd, Manchester

Burton, C. W., Makers of Cranes, Lifts, Pulley Blocks, &c., 158, Queen Victoria-st, London, E.C. (*Hibou London*)

Burton, F. G., Electrical Engineer, 1, Great Woodstock-st, London, W.

Burton, W. F., Electrical Engineer, 10, John-st, Mayfair, London, W.

Burys & Co, Limited, Manufacturers of Steel Castings, Forgings, &c., Sheffield; and 33, Gracechurch-st, London, E C.

BUSS-SOMBART (London Office: O. Berend & Co), 61, Fore-st, London, E.C. (*Yttrium London*)

Buss-Sombart's celebrated Tachometers and Tachographs (Recording Tachometers).

Butler Bros, Makers of Screws and Terminals, 4, Station-bldgs, Haggerston, London, N.E.

BUTLER, F. A., Mica and Talc Merchant, East London Mica Works, 68, Grosvenor Park-rd, Hoe-st, Walthamstow, London, E. (*Gneiss London*) **See Advt., p. 469**

Butler, H. B., Electrician, c/o G. F. Ratcliffe, Esq, 1, Wyndham-rd, Hagley-rd, Birmingham

Butler (H. W.) & Co, Dealers in Electrical Apparatus, 108, London-wall, London, E.C.

Butler, W. H., Telegraph Engineer, Postal Telegraphs, Central Station, General Post Office, St. Martin's-le-Grand, London, E.C.

Butterley Company, Limited, Iron Founders, Metal Casters, Engineers, and Contractors, Butterley Iron Works, near Derby; and 118, Cannon-st, London. (*Butterley Alfreton; Butterley London, 1807*)

Butterworth Bros, Gauge Glass and Lubricator Makers, Newton Heath Glass Works, Manchester. (*Glasses Newton Heath*)

Button (H.) & Co, Limited, Manufacturing Chemists, Faraday Works, Rainham, Essex; and 102, Fenchurch-st, London, E.C.

Buxton & Thornley, General Engineers and Boiler Makers, Burton-on-Trent. (*Engineers Burton-on-Trent*)

Byrne, P., Electric Bell Fitter, 43, S. Richmond-st, Dublin

Byrom & Phillips, Manufacturers of Slate Switches and Switchboards, Pipewellgate, Gateshead-on-Tyne

Byrt, A., jun, Dealer in Electrical Apparatus, 47, High-st, Shepton Mallet, Somerset

— C —

CABLE FLEET, The World's—*For particulars see p. 227*

Cable (J. W.) & Co, Leather Belting Manufacturers, 35, Clerkenwell-rd, London, E.C.

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Cadle, C., Turbine and Water-Wheel Maker, 39, Wellington-quay, Dublin. (*Cadle Dublin*)

Caiger, George, Electrician, 29, Radnor-st, Hulme, Manchester

Caird & Rayner, Engineers and Coppersmiths, 777, Commercial-rd, Limehouse, London, E. (*Vaporize London, 5210*)

Calder, A., Metropolitan Manager, National Telephone Company, Limited, 58 and 59, London-wall, London, E.C.

Caldient, H., Electrical Engineer, Parkhill Petroleum Tanks, Herculaneum Dock, Liverpool

Caldwell, W. E., Manufacturing Electrician, 27, South Sherwood-st, and Rigley's-yd, Nottingham

Caledonian Electric Supply Company, Limited, 40, Castle-st, Edinburgh. (Alex. F. Carmichael, Electrical Engineer)

Calipe, Dettmer & Co, Manufacturing Electricians, 21, Poland-st, W., and 80, Brockley-rd, Brockley, S.E., London

Callahan, Wm., Lightning Conductors Fitter, 183, Allander-st, Possilpark, Glasgow

CALLENDER'S BITUMEN, TELEGRAPH, AND WATERPROOF COMPANY, Ltd, Electric Cable Manufacturers, &c., 101, Leadenhall-st, London, E.C. (*4485*); Oldham-pl, Renshaw-st, Liverpool; Albert-st, Birmingham; 4, Water-st, Huddersfield-st, Hull; 74, Commercial-st, Dundee; and Great Western-rd, Kelvinside. Works: Erith, Kent (*8411*) (*Callender London*)

Sir Geo. R. Prescott, Bart. ... Chairman
T. O. Callender... ... ... Managing Director
S. C. Lambert ... ... Secretary

See also page 277.

Callender, T. O., Electrician, Managing Director, Callender's Bitumen, Telegraph and Waterproof Company, Limited, 101, Leadenhall-st, London, E.C.

Callieu & Bartlett, Mathematical Instrument Makers, 11A, Featherstone-bldgs, London, W.C.

Callow, C. B., Electrician, Tring Park, Tring, Herts.

Calthrop, E. R., Consulting Engineer, 56, Naylor-st, Liverpool; and Freshfield, Lancs. (*Calthrop, Liverpool, 5823*)

Calvert & Co., Limited, Mechanical and Electrical Engineers, Orchard Works, Orchard-st, Wandsworth, London, S.W.

Cambridge Electric Supply Company, Limited, 2, Sidney-st (*43*), and Thomson's-lane (*92*), Cambridge (*Electric Supply Cambridge*)

Hon. C. A. Parsons ... Managing Director
John H. Barker ... ... General Manager and Secretary

See also page 277.

Cambridge Scientific Instrument Company, Electrical and Scientific Instrument Makers, St. Tibbs-row, Cambridge. (*Instrument Company Cambridge, 6*)

Cambridge University and Town Electric Lighting Company, Limited, 63, Sidney-st, Cambridge

See also page 277.

Cambridge University, Cambridge. (*For list of Professors see page 264*)

Cambrook, John, Secretary of the West African Telegraph Company, Limited, Winchester House, Old Broad-st, London, E.C.

Cammell (Chas.) & Co, Limited, Ironfounders, and Telegraph and Telephone Wire Manufacturers, Cyclops Steel and Iron Works, Saville-st, Sheffield; and 26, Parliament-st, London, S.W. (*Cammell Sheffield*)

Campbell, A., Electrical Engineer, Messrs. Evered & Co, 28 and 29, Drury-lane, W.C., and 29, Bruce-rd, Willesden, N.W., London

Campbell (A.) & Son, Electrical Engineers, 48, South-rd, Waterloo, and 13, Seaforth-rd, Seaforth, Liverpool

Campbell, Albert, B.A., Electrician, Faraday House, Charing Cross-rd, London, W.C.

Campbell, Edward, Assistant Superintending Engineer, Postal Telegraphs, Edinburgh

Campbell Gas Engine Company, Limited, Hopwood-lane, Halifax; 99, Bothwell-st, Glasgow; 103, Snow-hill, Birmingham; and 114, Tooley-st, London, S.E. (*Camgas Halifax, 92*; *Simplicity Glasgow*; *Simplicity Birmingham*; *Amentum London*)

Campbell, George & Co, India Rubber Manufacturers, 108, Argyle-st, and 33, Jamaica-st, Glasgow (*Vulcanite Glasgow*)

Campbell, John, Electrician, &c., Inverlochy Castle, by Fort William, Inverness-shire

Campbell, Macmaster & Co, Consulting Engineers and Manufacturers' Agents, Botolph House, 10, Eastcheap, London, E.C. (*Duke London, 2011*)

Campbell, Peter, Electrical and Mechanical Bellhanger, 68, George-st, Perth

Canadian Electrical Insulations Company, Mica Merchants, 78, Long-lane, London, E.C.

Canavan, R. J., Electrician, 27, Tavistock-pl, Tavistock-sq, London, W.C.

Cannell, Charles, Electric Tell-tale Clock Maker, near Thorpe Asylum, Norwich. (*112*)

Cannell, E. S., Electric Light Engineer, City Asylum, Norwich. (*27*)

Canning (Sir Samuel) & Co, Consulting, Civil and Electrical Engineers, 3, Great Winchester-st, London, E.C.

Canning (W.) & Co, Makers of Electro-plating Dynamos, Great Hampton-st, Birmingham. (*Materials Birmingham*)

Cannington, Shaw & Co, Limited, Glass Manufacturers, Sherdley Glass Works, St. Helens; and at Liverpool, Manchester, Glasgow, and London. (*Cannington St. Helens, 11*; *Cannington Liverpool, 554*; *Cannington Manchester*; *Sherdley Glasgow, 4170*; *Sherdley London*)

Cannon, W. G., Electrical Engineer, 110, London-road, Southwark, London, S.E.

Canterbury Electricity Supply Company, Ltd., 49, Queen Victoria-st, London, E.C.

See also page 277.

Cape Copper Company, Limited, 9, Queen-st-pl, London, E.C. (J. C. Leaver, Secretary) (*1956*)

Capel & Co., Engineers, Shafting and Pulley Makers, Hartwell-street Works, Dalston Junction, London, N.E. (*Educate London*)

Capel, Henry, Electrician, London Electric Wire Company, Limited, Playhouse-yard, Golden-lane, London, E.C.

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Cape Town and Suburban Electric Lighting Syndicate, Limited, 6, Great Winchester st, London, E.C. (Davis & Soper, Agents) (*Reposnos London, 4481*)

*Capito, Chas., Consulting Engineer, Penywern House, 2, Penywern-rd, Earl's Court, London, S.W.

Caplatzi, A., Electrical Sundriesman, 3, Cheniesst, Tottenham Court-rd, London, W.C.

Capon, Heaton & Co, Limited, Insulating Material Manufacturers, Lifford's Mill, King's Norton, Worcestershire; and 48, Union-passage, Birmingham

Cappel, Sir Albert J. Leppoc, K.C.I.E. (late Director-General of Indian Government Telegraphs), Director of the Eastern Telegraph Company, Limited, the Eastern Extension Telegraph Company, Limited, and the Anglo-American Telegraph Company, Limited, &c., 27, Kensington Court-gdns, London, W.

Carboid Oil-less Bearing Company, Limited, Makers of Hedge's Mica Foil Fuses, 7, Carteret-st, Westminster, London, S.W. (*Soojee London*)

Carbon Battery Company, Limited, Electricians, Electrical Engineers and Battery Manufacturers, 10, Mildmay-chambers, 7, Union-court, Old Broad-street, London, E.C.

See also page 277.

Carbon Electric, Limited, Makers of Carbon Rods and Plates, 33, Old Broad-st, London, E.C.

See also page 278.

Carbone, Le (late Lacombe & Co), Manufacturers of Electric Light Carbons, 7, Carteret-st, Westminster, London, S.W. (*Lacombe London*)

(*See also* CONTINENTAL DIVISION.)

*Cardew, Major Philip, R.E., Electrical Adviser to the Board of Trade, 8, Richmond-ter, Whitehall, London, S.W.; and Janoway Hill, Woking, Surrey

Carlaw, David, Mathematical Instrument Maker, 81, Dunlop-st, and 54 to 56, Ropework-lane, Glasgow. (*David Carlaw Glasgow, 820*)

Carloss, Herbert, Electrical Engineer, 41, Castle-rd, Southsea

Carmichael, Alex. F., C.E., Electrical Engineer and Manager, Caledonian Electric Supply Company, Limited, 40, Castle-st, Edinburgh

Carpenter, Arthur, Electrical Engineer, Electric Light Station, Larne, co. Antrim

Carpmael & Co, Patent Agents, 24, Southampton-bldgs, London, W.C. (*Carpmael London, 2608*)

Carr, Byrom, Electrician, Lecturer in Electro-Metallurgy, Technical School, Sheffield

Carr, Charles, Electric Bell Manufacturer, Woodland Works, Grove-lane, Smethwick, Birmingham

Carr, George M., Telegraph Engineer, Postal Telegraphs, Sunderland

Carr, Capt. George, R.E., Electrical Engineer, 2, Marlborough-villas, New Brompton, Kent

Carr, W. T., Engineer to the Crystal Palace Company, Sydenham, London, S.E.

Carrick & Ritchie, Electrical Engineers and Contractors and Turbine Manufacturers, Waverley Engineering Works, near Abbey Hill Station, Edinburgh (*Crane Edinburgh*)

Carrick & Wardale, High-Speed Steam-Engine Makers, Gateshead-on-Tyne. (*Wardale Gateshead*)

Carrington, W., Civil Engineer, Messrs. Bullivant & Co., 72, Mark-lane, E.C., and Millwall, E., London

Carron Company, Metal Castings, Carron, Stirlingshire, N.B.; 125, Buchanan-st, Glasgow; 15, Upper Thames-st, London, E.C.; and at Manchester, and Liverpool. (*Carronade Carron, 14; Carronade Glasgow, 833; Carronade London, 1890*)

Carruthers (J. H.) & Co, Engineers, Makers of Steam or Electric Pumps, Polmadie Iron Works, Glasgow. (*Hoisting Glasgow, 3601*)

Carson (F. M.) & Co, Iron Merchants, 6 Fenchurch-st, London, E.C.

Carson, J. H., Manager Anglo-American Telegraph Company, 26, Old Broad-st, London, E.C.

Carson (Walter) & Sons, Manufacturers of Varnishes and Paints, Grove Works, Lombard-rd, Battersea, London, S.W. (*Carsons London. 9069*)

Carson, William, M.Inst.C.E., Electrical Engineer, Whitecross Wire and Iron Company, Warrington

Carswell, T. P., Electrical Engineer to the North British Railway Company, Engineer's Office, Glasgow.

Carter, E. Tremlett, F.R.A.S., Electrical and Mechanical Engineer, Broadclyst, 53, Cloudesdale-rd, Upper Tooting, London, S.W.

Carter, F. S., A.I.E.E., Electrical Engineer, Woodleigh, Holland-road, Chorlton-cum-Hardy, and c/o Messrs. Stott & Sons, 60, Haworth's-bldgs, Cross-st, Manchester

Carter, G. H., Electrician, 65, Torriano-av, London, N.W.

Carter, James Harrison, Consulting Engineer, 82, Mark-lane, London, E.C. (*Milling London*)

Carter (J.). Sons & Co, Engineers, Tool Makers, &c., New Bailey-st, Salford, Manchester. (*Carters Engineers Salford; Nat. 1875, New 494*)

Carter, R., Electrical Engineer, Thetford Electric Light Company, Limited, St. Nicholas-st, Thetford

Carter, W. C., M.I.Mech.E., Consulting Mechanical and Marine Engineer, Mansion House-chmbrs, Queen Victoria-st, London, E.C. (*Tympanum London*)

Cartland (James) & Son, Manufacturers of Electric Light Fittings, Brass Foundry, Birmingham; and 57, Holborn-viaduct, London, E.C.

Cartledge & Batchelor, Mica and Spelter Merchants, 16, Water-lane, London, E.C.

Cartmell, J. Monkhouse, Dealer in Electrical Machinery, 35, West George-st, Glasgow. (*Monkhouse Glasgow, 4377*)

Cartwright, C. F., Electrician, 32, Old Burlington-st, London, W.

Cartwright, J., Electrical Engineer, Central Electric Light Station, Bury, Lancs.

Carver, Thos. A. B., B.Sc., C.E., Private Assistant and Secretary, Physical Laboratory, The University, Glasgow

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Casella, Louis P., Meteorological and Electrical Instrument Maker, 147, Holborn-bars, E.C. (*Escutcheon London*)

Caslake, James, Art Metal Worker, 152 Kentish Town-rd, London, N.W.

Cassell & Co, Limited, Technical Publishers, La Belle Sauvage, Ludgate-hill, London, E.C. (*139*)

Castle Rubber Company, Limited, India Rubber Manufacturers, King William-st, London, E.C. Works: Warrington

Cathcart, C. H., Electrical Engineer, Sutton, Surrey

Cathcart, Peto & Radford, Manufacturing Electrical Engineers, Hatton Garden Electric Works, 57B, Hatton-gdn, London, E.C. (*Concentration London*)

Catley, Edward, Telegraph Engineer, Postal Telegraph Factory, Bovey-pl, Holloway, London, N.

Catterson (S. P.) & Sons, Limited, Manufacturers of Lamps, Shades, Electric Fittings, &c., Globe Lamp Works, Newington-causeway, London, S.E.

Cauderay, Jules, Electrician, 61, Charlotte-st, Portland-pl, London, W.

Causer (W.) & Co, Hydraulic and General Engineers, Soho, Birmingham. (*Causer Soho Birmingham*)

Causer, W. G., M.I.M.E., Consulting Engineer. 48, St. Paul's-sq, Birmingham. (*Causer Birmingham*)

Causley, S. & C., Makers of Casings and Covers for Electric Wires and Cables, 33, High-st, Kingsland, London, N.E.

Caustic Soda and Chlorine Syndicate, Limited, 58, Lombard-st, E.C., and Central Works, Penarth-street, Old Kent-road, S.E., London (C. O. Greenwell, Secretary)

Cave, L. T., Electrician, Ditcham Park, Petersfield

Cawley, G., Consulting Engineer, 29, Great George-st, Westminster, London, S.W.

Caws, Frank, Telegraph Engineer, 22, Fawcett-st, Sunderland

Cecil, Lord S. A., M.I.E.E., The Oast House, Hayes Common, Beckenham, Kent. (*Oasthouse London*)

Central Electrical Engineering Company, Manufacturers of Haslam's Storage Battery, 105, Abbey-st, Dublin

Central Engineering Works, Electrical and Mechanical Engineers, Low Friar-st, Newcastle-on-Tyne

Central Ironworks Company, Limited, Mechanical and Electrical Engineers, Central Iron Works, Rockingham-lane, Sheffield

CENTRAL LIGHTING STATIONS OF THE UNITED KINGDOM — *see folding sheet between pages 158 and 159*

Central London Railway Company, 30, St. Swithin's-lane, London, E.C.
T. Matesdorf ... ... Secretary
See also page 278.

Central News, Limited, Telegraphic News Agency, 5, New Bridge-st, Ludgate-circus, and 5, Austinfriars, London, E.C. (John Moore, Manager.) (*2534.*)

Central Rail Traction Company, Limited, Electric Traction Engineers, 2, Great George-st, London, S.W.

Cetti, E., Chemical Apparatus Manufacturer, 36, Brooke-st, Holborn, London, E.C.

Chadburn & Son, Ships' Telegraph Manufacturers, Telegraph Works, 11, Waterloo-rd, Liverpool; 69, Anderston-quay, Glasgow; 105, Fenchurch-st, London, E.C. (*1246*); and Newcastle-on-Tyne. (*Chadburn Liverpool*)

Chadderton Ironworks Company, Limited, Makers of Mechanical Stokers, &c., Irk Vale, Chadderton, near Manchester; and 10, Mark-lane, E.C. (*Disinfect Manchester; Disinfect London, 2424*)

Chagford and Devon Electric Light Company Limited, Chagford, Devon
G. H. Reed ... ... Manager and Secretary
W. J. McSweeney ... Electrical Engineer
See also page 278.

Challoner (T.) & Son, Electric Light and Power Engineers and Contractors, Blackpool, Lancs.

Challoner, W., Electrical Engineer and Manager of the Electrical Department, Messrs. T. Challoner & Son, Blackpool, Lancs.

Chalmers, Alex. B., Secretary Oriental Telephone Company, Telephone Company of Egypt, and China and Japan Telephone Company, 14, Austinfriars, London, E.C. (*Oakenpin London, 1367*)

CHAMBER OF COMMERCE, THE LONDON, Botolph House, Eastcheap, London, E.C. (*Convention London, 1160*) (*See* London Chamber of Commerce, *and page 263*)

Chamber of Commerce Journal—now incorporated with *Commerce* (q.v.)

Chamberlain & Hookham, Limited, Electrical Engineers, 4, New Bartholomew-st, Birmingham (*Solar Birmingham*)
See also page 278.

CHAMBERLAIN, H. & F., Manufacturers of Carbon Points, Battery Plates, &c., Barnsley, (*Carbon Barnsley*) **See Advt., p. 17**

Chambers, Joseph C., District Manager, National Telephone Company, Limited, 4, Albion-place, Leeds.

Chambers, Marcus S., Telegraph Engineer, 2, Knaresboro'-pl, Kensington, London, S.W.

Chambre, Alan E., Electrical Engineer, Camera Lodge, South Norwood, London, S.E.

Chamen, W. A., Electrician, "Crowley," Baker-rd, Harlesden, London, N.W.

Champion Rock-Borer and Air Compressor Company, Turbine Makers, &c., 63, Queen Victoria-st, London, E.C. (*Turnscrew London*)

Chance Bros & Co, Limited, Glass Manufacturers, Lighthouse Engineers and Constructors, near Birmingham (*Chance Lighthouse Smethwick*)
Makers of the Chance Mirrors and Diverging Lenses for Electric Search Lights and of the Chance Lenses for Ships' Electric Side Lights.

Chancellor & Son, Electrical Instrument Makers, 55, Lower Sackville-st, Dublin

*Chandler, Noel, Messrs. Bumsted and Chandler, Cannock Chase Foundry, Hednesford, Staffs. (*Bags Hednesford*)

Chapman, A. B., Electrical Engineer, Ipswich

Chapman, F. W. Morris, Electrician General Electric Company, 45, Chapel-st, Salford, Manchester

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Chapman, H., Electrician, Morley

Chapman, J. B., First-class Technical Officer, General Post Office, London, E.C.

CHAPMAN, J. C., A.M.I.C.E., M.I.M.E., Consulting Engineer and Patent Agent, Fel. Chartered Inst. Patent Agents, 70, Chancery-lane, London, W.C. (*Powerful London*)

See Advt., p. 87

Chapman & Son, Manufacturing Electricians, 11, Waterloo-rd; and 17, James-st, Liverpool

Chapman (Spencer) & Co, Acid Manufacturers, 36, Mark-lane, E.C., and Victoria Docks, Silvertown, E., London

Chappell H. J., Electrician, Carbon Electric, Limited, 33, Old Broad-st, London, E.C.

Charing Cross and Strand Electricity Supply Corporation, Limited, 12, Maiden-lane, Covent Garden, London, W.C. (*2645*)

E. Wilmot Seale, F.I.S.... Secretary and Manager

W. H. Patchell, A.M.I.C.E. Chief Engineer

See also page 278.

Charlesworth, Hall & Co, Electrical Engineers, Oldham, Lancs.

Charleton (R. J.) & Co, Electrical Engineers, 133, Pilgrim-st, Newcastle-on-Tyne; and at Scarborough (*Electric Newcastle-on-Tyne, 1221*)

Charlton (R. B.) & Co, Electrical Engineers, Manors Railway Station Works, Newcastle-on-Tyne. (*Charlton Manors Newcastle, 457 and 1746*)

Charnock, Prof. G. F., A.M.I.C.E., Professor of Electrical Engineering, Bradford Technical College, Bradford. (*321*)

Chartered Institute of Patent Agents, 19, Southampton bldgs, London, W.C. (For names and addresses of Fellows, *see p. 76*)

Chaster, John E., Consulting Electrical Engineer and Electrician, 42, Talbot-st, Southport, Lancs.

Chatham, Rochester and District Electric Lighting Company, Limited, 22, High-st, and Whittaker-st, Chatham (George Pepper, Secretary.) (*Electric Light Chatham*)

See also page 278.

Chatterton (Geo.) & Bazalgette, Consulting Engineers, 46, Queen Anne's-gate, Westminster, London, S.W.

Chattock, A. P., Professor of Physics, University College, Bristol

Chattock (F. E.) & Co, Wire Manufacturers, Hambro' Wharf, Upper Thames-st, London, E.C.

Chattock, R. A., Electrical Engineer, Metropolitan Electric Supply Company, Limited, Amberley-rd, Paddington, London, N.W.

Chatwin, Thomas, Maker of Engineers' Tools, Great Tindal-st, Birmingham; and 20, Victoria-st, Westminster, London, S.W. (*Chatwin Birmingham*)

Chauvin, G. von, Representative in England of the Western Union Telegraph Company, 252, Gresham House, Old Broad-st, London, E.C. (*Chauvin London*)

Cheap Wood Company, Timber Merchants, 72, Bishopsgate-st Within, London, E.C. (*1201*)

Cheeld, Sydney, Electric Light, Bell, and Telephone Contractor, Chesham, Bucks. (*Cheeld Chesham*)

Cheffey-James, George, Electrician, Bank-bldgs, George-st, Sheffield

Chelmsford Electric Lighting Company, Limited, Arc Works, Chelmsford, Essex

A. H. Pott ... ... Manager

F. R. Reeves ... ... Secretary

See also page 278.

Chelsea Electricity Supply Company, Limited, Offices, Draycott-pl, Sloane-sq; Generating Stations, Draycott-pl, and 91, Manor-st, Chelsea, London, S.W. (*Economy London*)

J. Irving Courtenay ... Chairman

Frank King ... ... Managing Engineer

Percy Still ... ... Resident Engineer

S. J. Cluer ... ... Secretary

See also page 278

Chemical News (weekly), Boy-ct, Ludgate-hill, London, E.C. (Price 4d.)

Chemical Society, Burlington House, Piccadilly, London, W. (H. E. Armstrong, F.R.S., and J. M. Thomson, F.R.S.E., Secretaries)

Chemical Trade Journal, The (weekly), 32, Blackfriars-st, Manchester. (Ann. sub., 12s. 6d.) (*Expert Manchester*)

Chester & Rathbone, Makers of the "Harp" Arc Lamp, 9, Grosvenor-gardens, Ealing, London, W.

Chetham-Strode, W., Electrician, 104, Bethune-rd, Stamford Hill, London, N.

Chevallier, Fielding, Telegraph Engineer, Cabletter, Waterville, co. Kerry

Chew, William, Electrical Engineer, Town Hall, and Trafalgar House, Lytham-rd, Blackpool

Chick, Edward, Electrical Instrument Maker, 24, Woodbridge-st, Clerkenwell, London, E.C.

Chili Telephone Company, Limited, 42, Old Broad-st, London, E.C. (*1468*)

Col. R. Raynsford Jackson ... Chairman

Fred. W. Kerr ... Gen. Manager in Chili

Edmund Petley ... ... Secretary

See also page 278.

Chilton, Free, Electrical Engineer, Adelaide-st, and Wellington-st, Luton, Beds

China and Japan Telephone Company, Limited, 14, Austinfriars, London, E.C. (*Oakenpin London, 1367*)

A. B. Chalmers ... ... Secretary

E. E. Porter (Shanghai) ... ... Electrician

See also page 278.

Ching, Comyn & Co, Electrical Engineers, &c. 54, 56, and 58, Castle-st, Long-acre, 22, and 23, Little St. Andrew-st, and 3, Little White Lion-st, London, W.C. (*Comyn Ching London, 2918*)

Chipperfield, R., Mode. Maker, 26A, Sekforde-st, Clerkenwell, E.C., and 99, Oxford-st, W., London

Chitty, Henry, Electrician, 5, Bolton-gdns, Chiswick, London, W.

Chivers, W. J., Electrician, 18, High-st, Sutton

Chloride Electrical Storage Syndicate, Limited, Makers of Storage Batteries, 8, King-st, Manchester. Works: Clifton Junction, near Manchester. (*Accumulate Pendlebury*) (G. A. Grindle, Works Manager)

See also page 278.

Christian, M., Electric Bell Fitter, 311, Cambridge-rd, London, E.

Christian, W., Manager Birmingham Electrical Supply Co, Ltd, 14, Dale-end, Birmingham

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Christie Bros, Makers of Electric Light Carbons, 188, St. Vincent-st, Glasgow. (*Chrisbros Glasgow*)

CHRISTIE, GEORGE, Limited, Brass and Copper Wire Drawers and Weavers, 51 to 57, Ladywell-st, Glasgow. (*Ladywell Glasgow.*) **See Advt., p. 643**

Christie, John, Electrical Engineer, 75, Waterloo-st, Glasgow

Christie, J. C., Electric Light Apparatus Maker, 3 and 5, Mansell-st, Aldgate, London, E. (*4384*)

Christie, W. H. M., M.A., F.R.S., Royal Observatory, Greenwich, London, S.E.

Christopherson (Clifford) & Co, Sulphate of Copper Agents, 17, Great Tower-st, London, E.C. (*Christopherson London, 2060*)

Christy Bros, Electrical Engineers, Bloomfield-rd. Works, Chelmsford, Essex. (*Engineering Chelmsford*)

Christy, Frank, Electrical Engineer, Christy Bros, Broomfield-rd, Chelmsford, Essex

Chrystal, Prof. G., F.R.S., Consulting Electrician, 5, Belgrave-cres, Edinburgh.

Chubb & Son's Lock and Safe Company, Limited, Electric Lock Manufacturers, 128, Queen Victoria-st, E.C., 68. St. James's-st, S.W., and (Works) 43, Glengall-rd, Old Kent-rd, S.E., London (*Chubb London, 1759*)

Church, George H., Electrician and Mechanical Engineer, Indian Telegraph Department, India Office, Charles-st, Westminster, London, S.W.

Churchill (Charles) & Co, Limited, American Machinery Importers, 21, Cross-st, Finsbury, London, E.C.; and 6, Albert-st, Birmingham. (*Opodeldoc London; Opodeldoc Birmingham*)

Churton, T. Harding, Electrical Engineer, Contractor and Manufacturer, (Offices) 5, South-parade, and Park Cross-st Works, Leeds (*933*)

Chutter, G. F., Electrical Engineer and Electrician, Buckingham-st, Birmingham

City of Bath Electric Lighting and Engineering Company, Limited, Electric Light Engineers and Contractors, Dorchester-st, Bath

T. O. Callender ... Chairman
G. F. Metzger ... ... Engineer & Mangr.
W. Jeffery ... . Secretary

See also page 279

City Electric Light Works—*see* Joel (H. F.) & Co.

City Electric Stores, Dealers in Electric Supplies, 31, Norton Folgate, Bishopsgate, London, E.C.

City and Guilds of London Institute for the Advancement of Technical Education, Gresham College, Basinghall-st, London, E.C. (John Watney, Hon. Sec.; A. L. Soper, Assist. Sec.)

City and Guilds of London Central Institution, Exhibition-rd, London, S.W. (*For List of Professors, &c., see page 269*)

City and Guilds Technical College, Leonard-st, Finsbury, London, E.C. (*For List of Professors, &c., see page 269*)

City of London Contract Corporation, Limited, Electric Light Contractors, &c., 3, Token-house-bldgs, King's Arms-yard, London, E.C.

City of London College, White-st, Moorfields, London, E.C.

I. Scarf, F.I.C., F.C.S. { Electricity and Magnetism
H. Adams, M.I.C.E. { Civil & Mechanical Engineering
D. Savage ... ... Secretary and Registrar

City of London Electric Lighting Company, Limited, 1 and 2, Great Winchester-st, E.C., Bankside, S.E., and (Stores) 107, Upper Thames-st, E.C., London. (*Pontyberem London, 4290*)

Sir David Salomons, Bt. ...Chairman
Prof. J. A. Fleming ... } Consulting Electrical Engineers
Prof. A. B. W. Kennedy ... } Consulting Electrical Engineers
Prof. S. P. Thompson ... } Consulting Electrical Engineers
David Cook ... ... Engineer and Manager
J. Cecil Bull ... ... Secretary

See also page 279

City of London Young Men's Christian Association, 186, Aldersgate-st, London, E.C.

A. G. Maddox, B.A.... Prof. of Electricity
Robert Burn ... .. Secretary

City and South London Railway Company. Limited (Electric), 46, King William-st, E.C.; and Stockwell-rd, S.W., London. (*Subway London*)

C. G. Mott ... ... Chairman
Sir John Fowler, Bart.... ... } Consulting Engineers
Sir Benj. Baker, K.C.M.G. ... } Consulting Engineers
James Henry Greathead, M.I.C.E. ... ... } Engineer-in-Chief
Basil Mott ... ... Engineer
P. V. McMahon ... ... Electrician
T. C. Jenkin .. .. Gen. Manager
W. F. Knight... ... ... Secretary

See also page 279

Civil and Mechanical Engineers' Society, 12, Delahay-st, Westminster, London, S.W.

Reginal Bolton, A.M.I.C.E. ... President
E. H. G. Brewster, A.M.I.C.E. Hon. Sec.

Clare, John E., Electrician and Mechanician, 55, Boundary-lane, West Derby-rd, Liverpool

Claret, Alfred J., Electric Bell Fitter, 55, Longford-st, London, N.W.

Clark (A.) & Co, Limited, Electric Light Fittings Manufacturers, 33-39, Buchan-st, Glasgow

Clark, A. M. & W., Patent Agents, 53 and 54, Chancery-lane, London, W.C. (*Klarean London*)

Clark, Bunnett & Co, Limited, Engineers, Rathbone-pl, W., 30, King-st, Cheapside, E.C., and New Cross, S.E., London

Clark & Co, Electric Lamp Manufacturers, 417, Brixton-rd, London, S.W.

Clark, E., Electrical Engineer (c/o Mr. Frank King), 39, Victoria-st, London, S.W.

Clark (F. A.) & Son, Lead Tube Makers, Marlborough Wharf, Hammersmith, London, W. (*Clarks Mills Hammersmith, 8531*)

Clark, Forde & Taylor, Electrical Engineers, 4, Great Winchester-st, London, E.C.

Clark (Frank W.) & Co, Limited, Electric Light Contractors and Engineers, 20, Abchurch-lane, London, E.C.

Clark, G. P., Electrical Engineer, 10, Lansdowne-rd, Holland Park, London, W.

Clark, J. H. E., Non-Magnetisable Watch Maker and Electrician, 86, Fetter-lane, London, E.C.

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Clark, Joseph, Maker of Electric Cranes, Laisterdyke, near Bradford

*Clark, Latimer, F.R.S., Electrical Engineer, 11, Victoria-st, S.W., and 4, Great Winchester-st, E.C., London. (*Standfield London*)

CLARK (LATIMER), MUIRHEAD & CO, Limited, Electric Light and Telegraph Engineers, Dynamo Machine Makers, &c, 23, Regency-st, Westminster, London. S.W., and 115, Wellington-st, Glasgow. (*Regency London.*) **See Advt, p. 59**

See also page 2-9

Clark, R., Dynamo Casting Manufacturer, Cheapside, Spennymoor

Clark, Robert, Electrician, Taybank, Errol, N.B.

Clark, Walter, M.I.E.E., Electrical Engineer, Electrical Power Storage Company, Limited, Millwall, E., and 197, Algernon-rd, Lewisham, S.E., London

Clarke, A., Maker and Fitter of Electric Bells, 48, Legh-st, Warrington

Clarke Bros., Electrical Instrument Makers, 32, Bravington-rd, Harrow-rd, London, W.

Clarke, C. A., Electrical Engineer (Mix & Genest, Limited), 3, Delaunays rd, Crumpsall, Manchester

CLARKE, CHAPMAN & CO, Limited, Engineers and Contractors, Victoria Works, Gateshead-on-Tyne (*Cyclops Gateshead, 137 and 138*); 50, Fenchurch-st, London, E.C. (*4251*); Tower-bldgs, Water-st, Liverpool; and 81, St. Vincent-st, Glasgow. (*1453*) **See Advt., p. 46**

Clarke, Charles Beauclerc, Electrical Engineer, Belgravia, Belfast

Clarke & Co, Makers of Coal Saving Furnace Bars, Boilers, General Castings, &c., Forest-rd, Nottingham (*Forest Nottingham*)

Clarke, Daniel George, Chemical Glass and Apparatus Manufacturer, 48, Brunswick-close, London, E.C.

Clarke & Dunham, Makers of Lieuvain's "Needle" and other Lubricators, 24, Mark-lane, E.C., and Harrow Green Works, Leytonstone-rd, E., London. (*Dunham London*)

Clarke (J. F.) & Sons, Electric Light Engineers and Contractors, 49, Moorgate-st, and 41, Featherstone-st, London, E.C.

Clarke (R.) & Co, Turbine Makers, Union Iron Works, Henhurst-st, Queen's-rd, Manchester

Clarke, T., B.A., Electrician, Beground, Tankersley, near Barnsley, Yorkshire

Clarke, T. J., Electrical and Mechanical Engineer, Havelock Works, Leicester

Clarke, Thomas, Electrical Engineer, 156, Sloane-st, London, S.W.

Clarke, Thomas A. William, Electric Cable Machine Manufacturer, Havelock Works, Leicester

Clarkson, Alex., Mathematical Instrument Maker, 28, Bartlett's-bldgs, Holborn, London, E.C.

Claxton, R. Heywood, Manager of the North-Western District National Telephone Company, Limited, Manchester

Claxton, Wm. Newman, Manufacturing Electrician, West-st, Alford, Lincolnshire

Clay, C. B., M.I.E.E., Telephone Engineer, National Telephone Company, Oxford-ct, Cannon-st, London, E.C.

Clay, R. C., Electrician, 35, Kenwyn-rd, Clapham, London, S.W.

Claye, S. J., Limited, Mechanical and Electrical Engineers, Manor House Works, Long Eaton; and at Derby

Claypoole, W., A.Inst.E.E, Electrical Engineer, Phœnix Electrical and Mechanical Engineering Works, Phœnix-st, Derby

Clayton, George, Chemical Glass Blower, 42, Red Lion-st, Clerkenwell, London, E.C.

Clayton, Howlett & Co, Engineers and Ironfounders, Atlas Works, Woodfield-rd, Harrow-rd, London, W. (*Brickpress London*)

Clayton & Shuttleworth, Steam Engine Makers, &c., Lincoln; and 78, Lombard-st, London, E.C. (*Claytons Lincoln; Clayton Shuttleworth London*)

Clayton, Son & Co, Limited, Engineers and Boiler Makers, Moor End, Hunslet, Leeds; and 60, Queen Victoria-st, London, E.C.

Clegg, Arthur, Engineers' Tool Model Maker, 46, Barbican, London, E.C.

Clegg (Harold A.) & Co, Electrical Engineers and Art Metal Workers, 9, South-parade, St. Mary-st, Manchester (*1768*)

Clegg, James, Electrician, Brampton, West Norwood, London, S.W.

Clegg, John, Practical Engraver, Queen-st, Barnsley, Yorks.

Clelland, J., Electrical Engineer, Glasgow Athenæum, St. George's-pl, Glasgow

Clemens, E. T., Electric Bell Fitter, 187, Union-st, Plymouth

Clement, A. F., Telegraph Engineer North British Railway Company, 8, Princes-st, Edinburgh. (*53*)

Clephan, T. J. S., Electrician, Colliery and Mill Furnisher, 22, Standishgate, Wigan (*Clephan Wigan*)

Clerkenwell Electrical Stores, Dealers in Electrical Supplies, 50, Myddelton-st, London, E.C.

Cliff (John) & Sons, Makers of Stoneware for Electrical Purposes, 14, Royal Exchange, Leeds, and at Runcorn. (*Firebrick Leeds*)

Cliff (Joseph) & Sons, Telegraph Insulator Manufacturers, Baltic Wharf, Commercial-rd, Waterloo Bridge, London, S.E.; and 2 and 4 Wharves, Great Northern Goods Station, King's Cross, London, N. (*Cliffs London, 4631*)

Clifford (Charles) & Son, Limited, Makers of Copper Tape and Rods for Electrical Purposes, Dog Pool & Fazeley-st, Birmingham. (*Clifford Birmingham*)

Clifford, Henry, C.E., Electrical Engineer, 1, Lansdowne-pl, Blackheath, London, S.E.

Clifford, R. C., Electrical Engineer and Maker of High-speed Engines, 151, Westgate, Bradford, Yorks.

CLIFT (LESLIE E.) & CO, Draughtsmen, Engineers and Zincographers, 1, Holborn-pl, High Holborn, London, W.C. (*Photogravure London.*) **See Advt., p. 565**

Clifton, G. B., Electrical Engineer, Great Western Railway Electric Light Works, Paddington Station, and 150, Westbourne-ter, London, W.

Clifton, Robert Bellamy, F.R.S. (Professor of Experimental Philosophy in the University of Oxford) Clarendon Laboratory, Oxford

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Clinton, W. C., Electrician, c/o Prof. J. Perry, F.R.S., City and Guilds of London Institute, Leonard-st, City-rd, London, E.C.

Clirehugh, S. V., Electrical Engineer, 68, Victoria-st, London, S.W.; and Temple-chmbrs, Brasenose-st, Manchester

Cloes, Emile, Maker of Iron and Steel Tubes, 122, Cannon-st, London, E.C.

Clubbe (Ernest J.) & Co., Electrical Engineers, Makers of Fitzgerald's Improved Secondary Batteries, 10, Elm-st, and (Works) 7, Cockitt-yd, London, W.C.

Cluer, S. J., Secretary Chelsea Electricity Supply Company, Limited, 2, Draycott-pl, Chelsea, London, S.W.

Clunn, J., Electrical Engineer, Victoria Hotel, Victoria-st, Liverpool

Cluse, William, Art Metal Worker, 187, Tottenham Court-rd, London, W.C.

Clutterbuck, G., Electrical Engineer and Contractor, 1A, Queen's-rd, Peckham, London, S.E.

Coad, T., Electrician, 26, Lynmouth-rd, Stamford Hill, London, N.

Coalbrookdale Company, Limited, Makers of Electric Light Fittings, Coalbrookdale, Salop; and Victoria Embankment, New Bridge-st, London, E.C. (*Severndale London*)

Coates, H. J., Electrical Engineer, 11, Nelson-st, Broughton, Manchester

Cobbett, Arthur R., Electrical Engineer (Roger Dawson, Limited), 53, Berners-st, London, W.

Cobbett, W. W., Maker of Cotton Machine Belting, 82, Southwark-st, London, S.E. (*Scandinavia London*)

Cochran, A. & R., Manufacturers of Globes for Electric Lighting, St Rollox Flint Glass Works, Glasgow. (*Ruby Glasgow*)

Cochran & Co, Engineers and Boiler Makers, 54, Duke-st, Birkenhead; and 2, Talbot-court, Gracechurch-st, London, S.E. (Chas. Booth, Agent) (*Multitubular Birkenhead*)

Cochrane, Ernest J., Assistant Engineer, Scottish House-to-House Electricity Co's Works, Coatbridge, N.B.

Cochrane, Grove & Co, Engineers, Iron Founders, &c., 11, Queen Anne's-gate, London, S.W.; and Ormesby Works, Middlesborough-on-Tees

*Cockburn, A. C., F.C.S., Consulting Electrical Engineer, 22, Streatley-rd, Brondesbury, London, N.W.

Cockerill, Thos., A.I.E.E., Electrician, 105, Derby-st, Bolton, Lancs.

Cockill, Henry F., Dynamo Belting Manufacturer, Mount View Leather Works, Cleckheaton. (*Cockill Cleckeaton, 1327*)

Cockrell (E. C.) & Co., Dynamo and Gas Engine Oil Manufacturers, Grosvenor-chmbrs., Deansgate, Manchester; and Springfield Oil Works, Salford. (*Aquila Manchester*)

Coe & Smith, Electric Bell Makers, 11, Denmark-st, Soho, London, W.C.

Coghill (H.) & Son, Manufacturers of Borax and Boracic Acid, Newcastle-under-Lyme; and 19, Hanover st, Liverpool (*Coghill Newcastle Staffordshire; Borax Liverpool, 2204*)

Cohen (Aaron) & Co, India Rubber Merchants, 161, Great Dover-st, and 8, Bankside, and Swan-st, London, S.E.

Cohen (Louis) & Co, Makers of Electric Batteries, Appliances, &c., Central Beach, Blackpool

Coignet & Co, Chemical Manufacturers, 150, Fenchurch-st, London, E.C. (*Coignet London*)

Coil Clutch & Pulley Company, Limited, Makers of Pulleys, Clutches, &c., Ashton gate, Bristol. (*Transmitter Bristol*)

Colchester Electric Light and Power Company, Limited, 5, North-hill, Colchester

Cole, F. G., Electrical Engineer, 4, Edith-rd, West Kensington, W., and 112, Belvedere-rd, Lambeth, S.E., London.

Cole, John Robert, Electrician, 67, Freeman-st, Great Grimsby

Cole, Marchent & Morley, Engine Builders and Manufacturers of Electric Power Plant, Prospect Foundry, Bradford, Yorks. (*Cole Bradford, 690*)

Cole, R. S., Electrician, 18, Haddingdon-rd, Stoke, Devonport

Coleman, Alfred, Electrical Engineer, National Telephone Company, 95, Colmore-row, Birmingham. (*National Birmingham, 24*)

Coleman, E. J., Electrician, 293, Lower-rd, Rotherhithe, London, S.E.

Coles, J., Electrical Engineer, &c, 840A, Old Kent-rd, London, S.E.

COLLEGES, SCHOOLS, and UNIVERSITIES—*see pages 264 to 273*

Collett, John, Director of Navy Contracts, Admiralty, Whitehall, London, S.W. (*1704*)

*Collett, Richard, Secretary of the Brazilian Submarine Telegraph Company, Winchester House, Old Broad-st, London, E.C. (*Amulet London*); and 19, St. Mary's-rd, Harlesden, Middlesex

Collett, Sydney, Secretary of the Globe Telegraph and Trust Company, Limited, Winchester House, Old Broad st, E.C.

Colley's Patents, Ltd, Telegraph Paper Makers, 147-150, Great Saffron-hill, London, E.C.

Collier (Edward) & Sons, Glass Screw Makers, Ivory Turners, &c., Stour Valley Works, Barker-st Parade, Birmingham

Collier, Arthur T., Telephone Engineer, Netria, St. Albans, Herts; and Derby-st, Oxford-rd, Manchester

Collier-Marr Telephone and Electrical Manufacturing Company, Limited, Telephone and Electrical Apparatus Manufacturers, Derby-st, Oxford-rd, Manchester (*1048*) (*Audible Manchester*)

H. S. Foster, M.P. ... Chairman
Arthur T. Collier ... Managing Director
J. W. Provis ... ... Secretary

See also page 279

Collin, Harry G. B., Electrician and Telephone Engineer, 13, Church-gate, Leicester

Collingridge Bros. Metal Refiners, 60 and 62, Clerkenwell-rd, London, E.C.

Collings, W. A., Electrical Engineer, Messrs. Siemens Bros. & Co, Limited, 12, Queen Anne's Gate, London, S.W.

Collins, Adrian C., Electrical Engineer, Electric Light Regulating Syndicate, Limited, 61, Old Broad-st, London, E.C.

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Collins, B. H., Secretary, Liverpool Electric Supply Company, Limited, 15, Highfield-st, and 154, Canning-st, Liverpool

Collins & Co, Electrical Engineers, Advance Works, 197 and 199, Balsall Heath-rd, Birmingham

Collins, Laurence, Assistant Superintending Engineer, Postal Telegraphs, Southern District, Cork

Collins, Walter Hepworth, Ph.D., B.Sc., F.C.S., F.G.S., F.R.M.S., Analytical Chemist, Assayer, and Consulting Chemical Engineer, Bradford-chmbrs, Mawdsley-st, Bolton; and Manchester (*Collins Analytical Chemist Bolton*)

Collis & Co, Electrical and Mechanical Engineers, West Quay Ironworks, Southampton

Collis & Co, Electro Plate Manufacturers, 57, Cambridge-st, Birmingham

Collis (John) & Co, Draughtsmen & Engravers, 166, Fleet-st, London, E.C.

Collis, W. H., Liverpool Electric Supply Company, Limited, 15, Highfield-st, and 107, Kingsley-rd, Liverpool

Collyer Bros, Electric Bell Manufacturers, 4, Edith-ter, Glyn-rd, Clapton, and 155, Wick-rd, Hackney, London, N.E.

Colquhoun, John Alexander, Electrician, 67, Gibson-st, Hillhead, Glasgow

Colson, A., Consulting Engineer, Gas Offices, Leicester

Colson, T. M., Electrical Engineer, 3, Adam-st, Adelphi, London, W.C.

Colston, Robert, Electrician, 13, Connaught-st, London, W.

Coltman, R. H, Electrical Engineer, Midland Electrical Works, Station-st, Burton-on-Trent

Column Printing Telegraph Syndicate, Limited, 5, New Bridge-st, and 3, Copthall-ct, E.C., and 4, Panton st, S.W., London

Combe (A.) & Co, Electrical Engineers, 21, Arthur-st, New Oxford-st, London, W.C.

Combe, George, Electrical Engineer, 3 High-st, Belfast. (*Potential Belfast*)

"Comet" Lighting and Heating Syndicate, Limited, 7, Nicholas-lane, London, E.C.

COMMERCIAL CABLE COMPANY (Mackay-Bennett System) (Head Office: Bishopsgate House, 55 and 56, Bishopsgate-st Within, E.C.), 23, Royal Exchange (*Yakcom London, 1146*), 16, Mark-lane (*2164*), East India-avenue, Leadenhall-st, E.C., 11, Duke-st, London Bridge, S.E. (*4878*), and 1, Northumberland-avenue, W.C. (*35145*), London; F3, Exchange-bldgs, Liverpool (*434*); 67, St. Vincent-st, (*3349*), and 40, Hope-st, Glasgow; Carlton-chmbrs, Baldwin-st, Bristol (*61*); Richmond-st, Weston-super-Mare; 18, Moult-st, Manchester (*1608*); 8, Forster-sq, Bradford (*773*); 29, Sandhill, Newcastle-upon-Tyne (*1356*); 37, Albert-sq, Dundee (*554*); 82, George-st, Edinburgh (*384*); 5, Bernard-st, Leith (*589*); Cory's-corner, Bute Docks, Cardiff (*156*); and 15, Adelaide-st, Swansea (*139*). (*See also* AMERICAN DIVISION)

G. H. Bambridge } General Superintendent Great Britain

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Commerce (illustrated weekly), Talbot House, Arundel-st, London, W.C. (Ann. sub., 28s.; single copies, 6d.) (*Embankment London*)

Commercial Contract Corporation, Limited, Electrical and General Contractors, 58, Lombard-st, London, E.C. (Charles Okey Greenwell, Secretary) (*11159*)

Commercial Telegram Bureaux, 11, Token-house-yard, London, E.C. (*Comtelburo London, 823*)

Comitti (O.) & Son, Scientific Instrument Makers, 69, Mount-pleasant, Gray's Inn-rd, London, W.C.

Commans & Co, Mining Machinery Manufacturers, 17, Gracechurch-st, London, E.C. (*Adelaide London*)

Commissary-General of Ordnance, Royal Arsenal, Woolwich. (*Ordnance Woolwich*)

COMMISSIONERS OF WORKS AND PUBLIC BUILDINGS, 12, Whitehall-pl, London, S.W. (*For Officials, see p. 231*)

Common, Andrew Ainsley, F.R.S., Electrical Engineer, 83, Wigmore-st, and 63, Eaton-rise, Ealing, London, W.

Common Petroleum Engine Company, Limited, Petroleum Engine Makers, 21, Lime-st, London, E.C.

Compagnie Française du Télégraphe de Paris à New York, 24, Royal Exchange, London, E.C. (W. W. Howell, Representative in England.) (*See also* AMERICAN AND CONTINENTAL DIVISIONS) (*Telepany London, 2237*)

See also page 279

Compound Motor Company, Limited, Engineers, 103, Cheapside, London, E.C.

Compound Wire Syndicate, Wire and Cable Manufacturers, 19, King's Arms-yard, London, E.C. (Alfred Riley, Secretary). (*Aula London*)

Congdon, G. H., Dealer in Electrical Supplies, Trafalgar House, Great Newport-st, Charing Cross-rd, London, W.C.

Connah & Co, India Rubber Manufacturers, 73 and 75, Oxford-st, London, W.

Connell, F. R., Electrician, 24 Cavendish-rd, Brondesbury, London, N.W.

Connelly Motor Company, Limited, Makers of the Connelly Oil Motor, 28, Victoria-st, London, S.W. (J. Sharp, Secretary)

CONNOLLY BROS., Insulated Wire and Cable Makers, Blackley, Manchester. (*Connollys Blackley, 2361*) **See Advt., p. 475**

Conolly (Henry) & Co., Electric Light Engineers and Contractors, 42 and 42A Hampstead-rd, London, N.W.

Conradty, C., Carbon Rod, Battery Plate and Micro-telephone Carbon Maker (H. Mayer, Agent), 28, 29, and 30, Paternoster-row, London, E.C. (*See also* CONTINENTAL DIVISION)

Conrady (Eugen) & Co, Electrical and Mechanical Engineers, Fleece Mills, Keighley. (*Conrady Keighley*)

CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 109, Farringdon-rd, London, E.C. (*Induction London, 6617*)

C. L. W. Fitzgerald ... ... Chairman
C. Curtoys ... ... Secretary

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Continental Caoutchouc and Gutta Percha Company, 28 and 29, London-wall, E.C. (Jacob & Schreppel, Agents) (*Schreppel London*)

Cook, Alexander, A.I.E.E., City of London Electric Lighting Company, Limited, 1 & 2, Great Winchester-st, London, E.C.

Cook (Charles H.) & Son, Electrical Engineers, 41, Bolton-rd, Ashton-in-Makerfield, Lancs.

Cook, David, Engineer and Manager, City of London Electric Lighting Company, Limited, 1 and 2, Great Winchester-st, London, E.C.

Cook, Ernest H., D.Sc. (Lond.), F.I.C., Consulting Electrician, Clifton Laboratory, 27, Berkeley-sq, Bristol

Cook, T., Superintendent Commercial Cable Company, Edinburgh

Cook (W.) & Sons, General Engineers, Glasgow Steel Works, Washford-rd, Sheffield; 72, Bishopsgate-st Within, London, E.C.; and Glasgow. (*Crucible Sheffield; Crucible Glasgow, 173*)

Cook, Wm. W., Telephone Engineer, National Telephone Company, Limited, 58 and 59, London-wall, London, E.C.

Cooke & Askew, Electrical Engineers and Electricians, Playfair-rd, Southsea

Cooke, Barnard & Son, Mathematical Instrument Makers and Compass Adjusters, 44, Saville-st, Hull. (*Cooke Optician Hull, 308*)

Cooke, Conrad W., Consulting Electrical Engineer, 28, Victoria-st, London, S.W.

Cooke, E. J. Driving Band Maker, Parsonage, Manchester. (*Hides Manchester*)

Cooke, F. W., M.I.E.E., Assistant Telegraph Superintendent and Electrical Engineer, Great Northern Railway Company, Retford

Cooke, Gervase, Electrician and Mining Engineer, Certificated Manager to the Park Iron Mines and Collieries Company, Limited, Lydney, Gloucestershire. (*Gervase Whitecroft*)

Cooke (John) & Sons, Sealing Wax Manufacturers, 6, Oxford-court, Cannon-st, London, E.C.

Cooke (William) & Co, Limited, Telegraph Wire Manufacturers, Tinsley Steel, Iron and Wire Works, Sheffield; and 110, Cannon-st, London, E.C. (*Cooke Sheffield*)

Cooke, Wm. Cozens, Electrician, Edison and Swan United Electric Light Company, Limited, Ponder's End, Middlesex

Cookson & Co, Lead Manufacturers and Antimony Refiners, Newcastle-on-Tyne (*Cookson Newcastle-on-Tyne*)

Cookson, W. R., Electrical Engineer, Binfield Park, Bracknell, Berkshire

Coon, J. M., Electrician, Central Station, St. Austell, Cornwall

Cooper, Charles Friend, A.M.I.C.E., M.I.M.E., &c., Electrical and Mechanical Engineer, 3, Princes-mansions, Victoria-st, London, S.W. (*1140*)

Cooper, Charles Thos., Mathematical Instrument Maker, Russell-pl, 9, Old Kent-rd, London, S.E.

Cooper, Edward, Electrician, 8, Exhibition-rd London, S.W.

Cooper, H., Dealer in Electrical Apparatus 43, Alma-st, Sheerness

Cooper (Harold) & Co, Outside Electric Bracket Makers, 18 and 16, Kemble-st, and 3-6, Nag's Head-ct, Drury-lane, London, W.C.

Cooper, H. & J., Electric Light Contractors, 8, 9, and 10, Great Pulteney-st, Regent-st, London, W. (*Appointment London*)

Cooper, J. N., Electrician, 93, Southwood-lane, Highgate, London, N.

Cooper, John H., Electrician, 25, Roches-st, Limerick

Cooper, M., 1st Class Technical Officer, General Post Office, London, E.C.

Cooper & Pannett, Manufacturing Electricians, 169, Gray's Inn-rd, W.C., and 82, Newman-st, W., London

Cooper, T., M.A., Electrical Engineer, Oxford Electric Light Company, 45, Broad-st, and Spring Valley, Iffley-rd, Oxford

Cooper, T. L. Reed, Resident Secretary, Hove Electric Lighting Company, Limited, 79, Western-rd, Hove

Cooper, V. B. D., Civil and Electrical Engineer, Westminster-chmbrs, 5, Victoria-st, London, S.W. (*Megohm London*)

Cooper, W. R., M.A., Electrician, Woodlands, Clapham Park, London, S.W.

Cooper (Wm.) & Son, Manufacturers of Electric Light Fittings, 193, Aston-rd, Birmingham

Coote, Alfred W., Electrician, Local Manager of the Edison and Swan United Electric Light Company, Limited, Carr-lane, Hull

Coote, J. F., Electrician, Telegraph Works, Silvertown, Essex

Coote, R. J., Electrician, 117, Fore-st, Upper Edmonton, Middlesex

Cope & Collinson, Art Metal Workers 53, Berwick-st, Oxford-st, London, W.; and 61, Summer-row, Birmingham

Copeland (J.) & Co, Engineers and Boiler Makers, Pulteney-street Engine Works, Dobbies Loan, Glasgow; and 101, Leadenhall-st, London, E.C. (*Vulcan Glasgow, 3257*)

Copp, W. L., Electrician, Watchet, Somerset

Cordeaux, J. H., 1st Class Technical Officer, General Post Office, London, E.C.

Cording (John Charles) & Co, India Rubber Manufacturers, 19, Piccadilly, London, W.

CORLETT ELECTRICAL ENGINEERING COMPANY, Limited, Electrical Engineers and Contractors, Rowbottom-sq, Wigan; and 13, Mosley-st., Newcastle-on-Tyne. (North of England Agents for Crompton Dynamos and Motors). (*Corlett Wigan, 63; Corlett Newcastle-on-Tyne*)

G. Stephen Corlett ... Managing Director
W. Fairweather ... ... Manager

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Corlett, G. Stephen, Electrical Engineer, Corlett Electrical Engineering Company, Limited, Rowbottom-sq, Wigan. (*Corlett Wigan, 63*)

Cormack, J. D., B.Sc., Assistant Lecturer and Demonstrator in Technical Electricity, Yorkshire College, Leeds

Cornell, Wm., Electrician, 67, May-st, Fulham, London, S.W.

Cornish, V. K., Electrician, c.s. "Mirror," c/o Eastern Telegraph Company, 50, Old Broad-st, London, E.C.

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Cornwall Boiler Company, Limited, Boiler Makers, Roskear, Camborne, Cornwall. (*Boiler Camborne*)

Corry, Edward, Copper Merchant, 9, New Broad-st, E.C.

Corse (W. J.) & Co, Manufacturing Electrician, 17, Old Town-street, and Market-pl, Plymouth

Cort (Arthur) & Co (Agents in Great Britain for H. Rost & Co, Gutta-Percha Manufacturers, Hamburg), 277, Camberwell New-rd, London, S.E. (*Cort Camberwell*)

Cossor, Alfred C., Incandescent Lamp Maker, 67, Farringdon-road, London, E.C.

Costar, Alfred, Dealer in Electrical Supplies, 10, Church-st, Croydon

Cottam, George H., Corporation Electrical Engineer, Town Hall, Hanley, Staffs.

Cotsworth, W. J., Electrician, 138, Wilmslow-rd, Fallowfield, Manchester

*Cotterell, A. E., District Manager National Telephone Company, Limited, 95, Colmore-row, Birmingham. (*2*)

Cotterell, C. W. & A. E., Electrical Engineers, 18, Temple-row, Birmingham. (*129*)

Cotton Powder Company, Limited, Manufacturers of Safety Fuses and Electric Firing Appliances, 116, Queen Victoria-st, London, E.C. Works: Faversham, Kent

Cotton, R., Electrician, Claybury, Woodford Bridge, Essex

Cottrell, S. B., Engineer and Manager, Liverpool Overhead Railway Company, 31, James-st, Liverpool. (*Motor Liverpool*)

Couch, Charles Thomas, Electrician, 133, Cambridge-st, Pimlico, London, S.W.

Coulson, W. Arthur, Consulting Electrician, 57, West Nile-st, and 1, Ashton-gdns, Glasgow. (*2211*)

County of London and Brush Provincial Electric Lighting Company, Limited, 1 and 2, Great Winchester-st, London, E.C. (J. Cecil Bull, Secretary)

See also page 280

Couper (James) & Sons, Glass Globe Makers, City Glass Works, 19, Kyle-st, Glasgow. (*Coupers Glasgow*)

Coupier & Drouart, Manufacturers of Artistic Electric Light Fittings, 75 and 76, High Holborn, London, W.C.

Coupland (J.) & Co, Electro-Platers, 22, Sekforde-st, Clerkenwell, London, E.C.

*Courtenay, John Irving, Chairman and Managing Director of the Electrical Power Storage Company, Limited, Chairman of the Chelsea Electricity Supply Company, Limited, and of the United River Plate Telephone Company, Limited, 4, Great Winchester-st, London, E.C. (*Storage London, 338*)

Cousins, Archibald, Shafting and Pulley Factor, 303, Old-st, London, E.C.

Cousland (Archibald) & Co, Limited, Wire Drawers, Workers and Weavers, 12, York-st, and 37, Hunter-st, Glasgow; and 36, Leadenhall-st, London, E.C. (*Shuttle Glasgow, 3953*)

Couzens, George Edwin, Electrical Engineer, 219, 221 & 223, Commercial-rd, Landport, Portsmouth

Couzens, Henry, Slate Turner for Electrical and other purposes, 44, Gloucester-st, Queen-sq, London, W.C.

Couzens, W. H., Engineer-in-Charge, Electric Light Station, Taunton

Coveney Brothers, Manufacturing Electricians, 67, King-st, Ramsgate

Coventry Electric Tramways, Limited, Coventry (H. O'Neill, Secretary)

Coventry Electrical Engineering Company, Manufacturers of the Coventry Dynamo, Electric Motors, &c., Volt Works, Ryley-st, Coventry

Coventry Gas Fittings Company, Limited, Electric Light Engineers and Contractors, 20, High-st, Coventry. (*70*)

Cow (P. B.) & Co, India Rubber Makers, 46 and 47, Cheapside, and 66, Bread-st, London, E.C. Works: Streatham-common, S.W. (*Peter Cow London*)

Cowan, Chas, Consulting Engineer, 6, Great Winchester-st, London, E.C.

Cowan, David, M.I.C.E., Consulting Engineer, Falkirk, N.B.

*Cowan, E. W., Electrical Engineer, Vicarage-lane, Bowdon, Cheshire

Cowan, P. C., B.Sc., M.I.C.E., Consulting Engineer and Down County Surveyor, 48, Upper Arthur-st, Belfast; and at Downpatrick, Co. Down

Cowan & Co, Sealing Wax Manufacturers, 28 and 29, London-wall, London, E.C.

Cowans, Sheldon & Co, Limited, Makers of Electric Cranes, Carlisle. (*St. Nicholas Carlisle*)

Cowdy (Jeremiah) & Co, Limited, Engineers, Founders and Wire Drawers, 40A, Queen-st, E.C.; and King Street-yard, Southwark, S.E., London. (*Cowdy London*)

Cowie, Capt. A. H., R.E., Electrician, 7, Bedford-circus, Exeter

Cowles (Aluminium) Syndicate Company, Limited, Milton Works, Milton, near Stoke-on-Trent. (*Cowles Milton, Staffs*)

Cowley, John, Electrical Engineer, 32A, Tower-bldgs, Water-st, Liverpool (Representative of Messrs. Laing, Wharton & Downs). (*Aurora Liverpool*)

Cowley, Joseph, Glass Benders, 20, Lower Kennington-lane, London, S.E.

Cowlishaw, Walker & Co, Limited, Clutch and Pulley Makers, Etruria, Stoke-on-Trent. (*Cowlishaw Etruria Stoke-on-Trent*)

Cowper, Charles E., Consulting Engineer, 6, Great George-st, Westminster, London, S.W.

Cowpen and Blyth Electric Light Station—*see* Sanderson & Co

Cox, Arthur Wm., Electrician, Marina Villa, Duncan-rd, Southsea

Cox & Co, Electricians, Patentees and Manufacturers of Electrical Appliances, St. Dunstan's-chmbrs, 11, Fetter-lane, London, E.C. (E. J. Dale, Manager)

Cox, Frederick J., Mechanical Electrician and Optician, 56, Terminus-rd, Eastbourne

Cox, F. W. Pope, Electrician, Templeton-mansions, Earl's Court, London, S.W.

Cox, Harry Wm. Chas., Electrician, 51, Cricketfield-rd, Lower Clapton, London, N.E.

Cox, W. B., Electrical Engineer, Eastwood House, March, Cambs.

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*Cox-Walker, E. (Messrs. Cox-Walkers), North-Eastern Electric Works, Darlington

Cox-Walkers, Electrical Engineers and Manufacturers and Contractors, North-Eastern Electric Works, Darlington; and West Register-st, Edinburgh. (*Cox - Walkers Darlington*)

Coxeter (J.) & Son, Electrical Apparatus Makers, 4 and 6, Grafton-st, Gower-st, London, W.C.

Coxhead, Frederick Carley, Consulting Electrical Engineer, 27, Leadenhall-st, London, E.C.

Coxon, James, Electrician and Contractor, Chapel-st, Cheadle, Stoke-on-Trent. (*Coxon Electrician Cheadle*)

Coy, T. J., Electric Bell Fitter and Metal Worker, 164, Ferndale-rd, Brixton, London, S.W.

Cradley Boiler Company, Makers of Wood's Universal Boiler, Cradley Boiler Works, Cradley Heath, near Birmingham; and 113, Leadenhall-st, London, E.C. (*Boilers Cradley Heath*)

Cradock (Geo.) & Co, Wire and Wire Rope Makers, Wakefield; and 7, East India-avenue, London, E.C. (*Cradock Wakefield*)

Crampton, Thomas, Electrical Engineer, 4A, Tooks-ct, Furnival-st, London, E.C.

Crampton, Thomas P. C., Electrician, 12, Swinton-st, Gray's Inn, London, W.C.

Crampton (William J.) & Co, Electrical Engineers, 53, St. Andrew's-st., Cambridge; and Sawston, Cambs.

Crapper, Ellis H., Electrical Engineer and Lecturer in Electrical Engineering, Technical School, Sheffield. (*Crapper Technical School Sheffield*)

Craven Bros, Limited, Engineers and Electric Crane Builders, Vauxhall Iron Works, Manchester

Crawford and Balcarres, Earl of, K.T., F.R.S., 2, Cavendish-sq, and The Carlton Club, Pall Mall, London, S.W.

Crawford, Francis C., Telegraph Engineer, India Rubber, Gutta Percha and Telegraph Works Company, Silvertown, Essex

Crawford, Tyson, Electrician, Dollond & Co, 35, Ludgate-hill, and 62, Old Broad-st, London, E.C.

Crawford, William, Telegraph Engineer, 90, Abingdon-rd, London, W.

Crawley, C. W. S., Electrician and Electrical Engineer, 44, Castleton-rd, W., and 16, Red Lion-st, E.C., London. (*Secohm London, 6770*)

Crawter, Frank W., Electrician, 35, St. George-sq, Regent's Park, London, N.W.

Creak, Captain Ettrick W., R.N., F.R.S., M.I.E.E., 36, Kidbrooke Park-rd, Blackheath, London, S.E.

Credenda Tube Company, Limited, Makers of the Credenda Steel Tubes, Smethwick, Birmingham. (W. C. Stiff, Managing Director.) (*Credenda Birmingham*)

Creedon, —, Electrical Apparatus Dealer, 158, Gray's Inn-rd, London, W.C.

Cresswell (D. G.) & Son, Asbestos Manufacturers, Wellington Mills, Bradford, Yorks. (*Cresswell Bradford*)

Crews, Henry C., Electrical Engineer, Cornbrook Telegraph Works, Manchester

Cripps, G., Teacher in Electricity, Polytechnic Institution, 309 and 311, Regent-st, W., and 13, Vicarage-villas, Willesden, N., London

Crittall (Richard) & Co, Art Metal Workers and Manufacturers of Electroliers, 20, Baker-st, and 34, North-st, Manchester-sq, London, W. (J. A. Phillips, Electrician.) (*Crittall London*)

Croager Bros, Mill and Engineers' Furnishers, Oil Importers, &c., Chatham Works, Homerton, London, N.E.

Croft, W. J., Electrician, 9, Percy-st, Clevelandrd, Crumpsall, Manchester

Crofton, Edward, Electrician, 45, West Cromwell-rd, Earl's Court, London, S.W.

Crofts, Alfred, Maker of Small Dynamo Castings, 7, Water-st., Deal

Croggon & Co, Limited, Manufacturers of Electric Bell and Telephone Supplies, and Electric Light Fittings, 16, Upper Thames-st, London, E.C.; 19, Tithebarn-st, Liverpool; and 7, John-st, Glasgow. (*Croggon London, 1677*)

Cromartie, D. B., M.I.E.E., Electrician, Town and County Club, Bedford

*Crompton, R. E. B. (Messrs. Crompton & Co, Limited), Mansion House-bldgs, 4, Queen Victoria-st, E.C. (*1663*), and Thriplands, Kensington-ct, W. (*8695*), London

CROMPTON & CO, Limited, Electric Light Engineers and Contractors, Mansion House-bldgs, 4, Queen Victoria st, E.C. (*Crompton London, 1663*), and (Show-Rooms) 148, Brompton-rd, S.W. (*8500*), London. Works: 1, Lillie-rd, London, S.W. (*Albright London, 8630*); 79, Western-rd, Hove; and Arc Works, Chelmsford (*Crompton Chelmsford*).

See Advts., pp. 56, 302, and inside end cover

J. F. Albright, R. E. Crompton ... Managing Directors
F. R. Reeves ... ... Secretary

See also page 280

Crompton Electric Supply Company of Australia, Limited, Mansion House-bldgs, 4, Queen Victoria-st, London, E.C.

J. F. Albright ... ... } London Directors
R. E. B. Crompton ... ... }
Carleton F. Tufnell ... }
W. G. Whiffen ... ... }
John See, M.L.A., N.S.W. } Australian Committee of Management
W. Trotter, J.P. ... ... }
K. H. Buchanan ... ... }
F. R. Reeves ... ... Secretary

(*See also* COLONIAL DIVISION *and page 280.*)

Crompton-Howell Electrical Storage Company, Limited, Makers of Secondary Batteries, Mansion House-buildings, London, E.C. Works: New Dock, Llanelly. (*Porosity London, 1663; Electric Llanelly*)

J. F. Albright ... ... Chairman

See also page 280

Crompton & Fawkes, Makers of Wood Casings, &c., Mansion House-bldgs, London, E.C.; and Chelmsford

Crompton (T. Albert) & Co, Marine and General Engineers, 86, Leadenhall-st, London, E.C.

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Crook, Edwin, Electric Bell Fitter, 5, Carnaby-st, Regent-st, London, W.

Crook, Walter J., Metal Refiner, 35, Eastcheap, London, E.C.

Crookes, Joseph, Electrical Engineer, 111, Elgin-crescent, Notting Hill, London, W.

*Crookes, Prof. W., F.R.S., Consulting Electrical Engineer, 7, Kensington Park-gdns, London, W. (*Crookes London*).

CROSBIE, ADOLPHE, Limited, Manufacturer of Paints for all Ironwork and of Crosbie's Boiler Composition, Wolverhampton. (*Crosbie Wolverhampton, 7052*)

CROSBY LOCKWOOD & SON, Technical Publishers, Stationers' Hall-ct, London, E.C. (*Crosby Lockwood London.*) **See Advt., p. 52**

Crosby Steam Gauge and Valve Company, Manufacturers of Steam Engine Indicators, 75, Queen Victoria-st, London, E.C. (*Crosby London, 505*)

Crosier, Mills & Co, Manufacturers of Carbons, Dynamo Brushes, &c., 58, Collingwood-st, Newcastle-on-Tyne; and at Sunderland and Manchester. (*Cromil Newcastle, 1461*)

Crosland, F. L., Jun, A.M.I.C.E., Chief Engineer, Boiler Insurance & Steam Power Company, Limited, 67, King-st, Manchester

Cross (George) & Sons, Lightning Conductor Fitters, Smethwick

Cross & Bevan, Electro-Chemists, 4, New-ct, Carey-st, London, W.C. (*Phlcom London*)

Cross, —, Electrical Engineer, West Quay, Southampton

Cross, Harold G. E., Electrician, Potterdale Works, Dewsbury-rd, Leeds

Cross, W. E., Electrician, Egremont, Lawrie Park-rd, Sydenham, London, S.E.

Crossley Bros, Limited, Gas Engine Makers, Openshaw, Manchester; 10, St. Bride-st, London, E.C. (warehouse); 116, New-st, Birmingham; 19, Henfield-st, Newcastle; and Glasgow (*Crossleys Openshaw; Crossley Brothers London; Otto Glasgow; Eureka Birmingham; Crossley Brothers Newcastle*)

Crossley (C. W.) & Co, Air Propeller Manufacturers, 14, St. Mary-axe, London, E.C.

Crossley Telephone Company, Limited, Albany-bldgs, Market-st, Bradford (*Harrison Bradford*)

See also page 280

Crouch, A. P., Electrician, India Rubber, Gutta Percha and Telegraph Works, Silvertown

Crowe, J. T., A.I.E.E., Eastern Telegraph Company, Limited, Winchester House, Old Broad-st, London, E.C.

Crowe, Percy B., Mechanical and Electrical Engineer, 39, Victoria-st, London, S.W.

Crowley (John) & Co, Limited, Makers of Annealed Castings for Electrical Purposes, Meadow Hall Iron Works, near Sheffield; Kelham Iron Works, Sheffield; and 69, Corporation-st, Manchester. (*Crowley Meadow Hall Sheffield, 25*)

Crowley, Richard Joseph, Electrician, Harbour-row, Queenstown, Co. Cork

CROWN AGENTS FOR THE COLONIES, Downing-st, S.W. (*3336*), and 1, Tokenhouse-bldgs, E.C. (*73*), London. (*For Officials, see p. 233*)

Crown Electric Light Company, Limited, Makers of the Crown Arc Lamp, 80, Queen Victoria-st, London, E.C.

Crowther, E. P., Electrical Engineer and District Manager, Laing, Wharton and Down, Guardian-bldgs, Cross-street, Manchester. (*Crowther c/o Whardown Manchester, 1511*)

Crowther, John H., Electrician, 96, Bignor-st Cheetham, Manchester

Croydon Tramways Company, Thornton Heath, Croydon, Surrey

W. J. Carruthers-Wain ... ... Chairman
J. G. B. Elliott ... ... Secretary

See also page 280.

Cruikshank & Cook, Makers of Pulleys and Shafting, 74, Galbraith-st, Glasgow. (*Blowers Glasgow, 3673*)

Crum-Brown, Prof. Alex., M.D., Professor of Chemistry, University of Edinburgh, Edinburgh

Crystal Palace Company's School of Practical Engineering, Crystal Palace, Sydenham, London, S.E. (J. W. Wilson, Principal.

Crystal Palace District Electric Supply Company, Limited, Springfield Works, Upper Sydenham, London, S.E. (*Sustinere London, 9659*)

Robert M. Mayer ... Chairman
George Offor ... ... Managing Director
Frank King... ... ... Consult. Engineer
P. J. Rea ... ... Engineer

See also page 280

CUBA SUBMARINE TELEGRAPH COMPANY, Limited, 58, Old Broad-st, London, E.C. (*Silverbush London*)

Thomas Greenwood ... ... Chairman
J. Scott ... ... Secretary

See also page 280.

Cuff, J. C., Electrician, 25, College-green, Bristol

Culley, W. R., Submarine Superintendent Post Office Cable Depôt, Dover

Cumberland, J. B., Electrical Engineer, Messrs. Rooper & Tozer, 11, Bridge-st, Northampton

Cundall, J. H., A.M.I.C.E., Consulting Engineer, 121, Cannon-st, London, E.C; and Wickham House, Beaufort-rd, Kingston-on-Thames

Cunliffe & Croom, Engineers and Tool Manufacturers, Broughton Iron Works, Manchester. (*Lathe Manchester*)

Cunliffe Owen, E., C.M.G., Secretary Metropolitan Electric Supply Company, Limited, Winchester House, Old Broad-st, London, E.C.

Cunningham, R. M., Secretary London Platino-Brazilian Telegraph Company, Limited, and Western and Brazilian Telegraph Company, Limited, 19, Great Winchester-st, London, E.C. (*1381*)

Cunnington, J. S., Electrical Engineer (Messrs. B. Verity & Sons), 31, King-st, Covent Garden, London, W.C. (*2648*)

Cunynghame, H. H. S., Barrister-at-Law, Consulting Electrician, Hurlingham Lodge, Fulham, S.W., and 2, Paper-bldgs, Temple, E.C., London.

Curle, James A., Glass Blower, Homer-rd, Victoria Park-rd, London, E.

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Curra, John W., 2nd Class Technical Officer Engineer-in-Chief's Office, General Post Office, London, E.C.

Currie, Thomson & Co, India Rubber and Asbestos Manufacturers, 43-47, Jamaica-st, Glasgow; and 84, Newgate-st, London, E.C. (*Para Glasgow*)

CURTIS BROS, Electrical Engineers, Opticians, and Scientific Instrument Makers, 10, Suffolk-st, Dublin. (*Science Dublin, S.*)

Curtis, E. S., Electrician, c/o P. & O. S. N. Co, Leadenhall-st, London, E.C.

Curtis (William) & Sons, Electrical Engineers, 98 and 99, Middle Abbey-st, Dublin

Curtis-Hayward, A. C., B.A., A.I.E.E., Solicitor, 27, Chancery-lane, London, W.C. (*2739*)

*Curtoys, Charles, M.I.E.E., Secretary Consolidated Telephone Construction and Maintenance Company, Limited, 109, Farringdon-rd, London, E.C. (*Induction London, 6617*)

Cushing, Thomas, F.R.A.S., Electrician, India Store Depôt, Belvedere-rd, London, S.E.

Cutler (Samuel) & Sons, Electrical Engineers and Contractors, 16, Great George-st, Westminster, S.W., and (Works) Millwall, E., London

Cutting (F.) & Co, Electrical Engineers, 70, St. John's-hill, Wandsworth, London, S.W.

Cutting Bros. & Co, Electrical Engineers, Parliament Works, Parliament-st, Derby. (*Cutting Derby*)

Cutting (R. C.), Douglass & Co, Limited, Lightning Conductor Manufacturers, Wardrobe-chmbrs, Queen Victoria-st, London, E.C.

See also page 280.

Cuttriss, Wallis & Co, Limited, Manufacturing Electricians and Electrical Engineers, Elmwood Electrical Works, Camp-rd, Leeds. (*Cuttriss Leeds*)

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Cuttriss S. W., Electrical Engineer (Cuttriss, Wallis, & Co, Limited), 6, Fieldhead Tee, Camp-rd, Leeds

Cuzner, Geo., Dealer in Electrical Apparatus, Beckington, Bath

— D —

Dagger, Francis, Consulting Engineer, 15, Alder-st, Lyme Grove, Seaforth, near Liverpool

Daggit, R. G., Superintendent Commercial Cable Company, 15, Adelaide-st, Swansea (*130*)

Daimler Motor Syndicate, Limited, Engineers and Makers of the "Daimler" Motor, 95, Billiter-bldgs, 49, Leadenhall-st, London, E.C. (*Daimler London*)

Dalby, W., Electrician, 4, Everdon-pl, Main-st, Sparkbrook, Birmingham

Dale, C. J., Electrician, 63, Crouch-hill, London, N.

DALE, E. J., Electrical Engineer, 10, Cursitor-st London, E.C.

DALE, E. R., C.E., A.I.E.E., Electrician, Electric Light and Power Engineer and Contractor, Green-hill, Sherborne, Dorset. (*Dale Sherborne*)

Maker of and Dealer in all kinds of Electrical Apparatus.

Dale, H. J., Electrician, 7 and 8, Dyers'-bldgs, London, E.C.

Dale's Stores, Electric Light Contractors, Bournemouth

Dallas, J. Douglas, Electrical Engineer and Electrician, 10, Trevor-ter, Knightsbridge, London, S.W.

Dallmeyer, J. H., Limited, Optician and Optical Instrument Makers, 25, Newman-st, London, W. (*Dallmeyer London*)

Dalton, Samuel Thomas, Electrician, Bradford Corporation Electrical Works, Bradford

D'Alton, P. Walter, Chief Engineer, London Electric Supply Corporation, Limited, Stowage Wharf, Deptford, London, S.E. (*Gignentic London, 3800*)

Dalziel's Atlantic Telegram Company, Limited, 3, Angel-ct, Throgmorton-st, London, E.C.

Dalziel's Cable News Agency, Limited, 222, 225, Strand, London, W.C. (*2877*)

Dan Rylands, Limited, Glass Lined Tube Makers, Stairfoot, Barnsley; and at 3, Dyer's-bldgs, Holborn, London, E.C. (*Ryland-Barnsley; Rillands London, 2577*)

Dandridge, J. & A., (Old) Zinc Merchants, 15, Church-st, Deptford, London, S.E. (*8044*)

Daniel & Arter, Electro-Platers and Refiners, Globe Nevada Silver Works, Birmingham: and 62, Holborn-viaduct, London, E.C.

Daniell, Francis T. B., Electrician, c/o Messrs. Hickie, Borman & Co, 14, Waterloo-pl, London, S.W.

Daniel, G. A., Electrician, Nettlefolds, Limited, Castle Works, Tydu, near Newport, Mon.

Danks, H. & T., Limited, Engineers and Boiler Makers, Crown Boiler Works, Netherton, Dudley. (*Danks Netherton Dudley*)

Dann, Richard, Electric Light Engineer and Contractor, Union-st and 31, High-st, Maidstone. (*Richard Dann Maidstone*)

Darke, W. C., Electrician and Electrical Engineer, Wilmot-pl, Camden Town, London, N.W.

Darlaston Cycle Company, Mechanical and Electrical Engineers, Wire Drawers, &c., Pyramid Works, Foster-st, Darlaston, Staffordshire. (*Pyramid Darlaston*)

Darton (F.) & Co, Electrical Sundriesmen, 142, St. John-st, London, E.C. (*Exceptional London*)

Dashwood (Arthur) & Sons, Limited, Engineers, Sycamore Works, Wimbledon; and 28 and 29, St. Swithin's-lane, London, E.C. (*Dashwood Wimbledon*)

Dasnières, C., Chemical Merchant, 16, Philpot-lane, London, E.C. (*Dasnières London, 2154*) (*See also* CONTINENTAL DIVISION)

Daubeney, E. C., Electrician, 6, Grosvenor-hill, Wimbledon

Davey, George, Dealer in Electrical Apparatus, 14, Church-st, Stoke Newington, London, N.

Davey, Henry, Consulting Engineer, 3, Princes-st, Westminster, London, S.W.

DAVEY, PAXMAN & CO, Steam Engine Makers, Standard Iron Works, Colchester; and 78, Queen Victoria-st, London, E.C. (*Paxman Colchester; Paxman London, 169*)

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Davey, William J., Electrician, 151, Huddleston rd, Tufnell Park, London, N.

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Davidson, Archie, Electrician, 266, Trinity-rd, Wandsworth Common, London, S.W.

Davidson, E. S., Electrical Engineer, 6, Netherhall-gdns, South Hampstead, London, N.W.

Davies, A. F., Electrical Engineer (Messrs. Laing Wharton & Down), 82A, New Bond-st, W. and 17, Gracechurch-st, E.C., London. (*Whardown London, 3602*)

Davies (Arthur W.) & Co, Electrical Engineers, 1, St. George's-pl, Gloucester-rd, London, S.W.

Davies, Charles, Electrician, 53, Dorset-st, Baker-st, London, W.

Davies (C. E.) & Co, Dynamo Oil and Lubricating Grease Manufacturers, Grays, Essex. (*C. Davies Grays*)

Davies, C. Langdon—*see* Langdon-Davies, C.

Davies, David, Electrician, Oriental Waterproofing Company, Wallis-rd, Hackney Wick, London, N.E.

Davies (George) & Son, Patent Agents, 4, St. Anne's-sq, Manchester. (*Invention Manchester, 1017*)

Davies, Leonard Randal, Electrical Engineer, 39, Seething-lane, London, E.C.

Davies (Llewellyn) & Co, Electrical Engineers, 8, Fowkes-bldgs, Great Tower-st, London, E.C.

Davies, Rhys, Borough Surveyor and Engineer, Brecon, South Wales

Davies, Captain W. H., M.I.C.E., Managing Director, Exchange Telegraph Company, Limited, 17 and 18, Cornhill, E.C., and 51, Tregunter-rd, S. Kensington, S.W., London

Davis, A., Electrician, 1, Mitcham-rd, Tootingjunction, London, S.W.

Davis, Albert L., A.I.E.E., Electrical and Consulting Engineer, Endoby, Guernsey

Davis Bros, Dealers in Electrical Supplies, 69, St. John-st-rd, London, E.C.

Davis & Co, Limited, Electric Light Apparatus Makers, Gorleston, Great Yarmouth. (F. W. Carver, Manager)

Davis (Edward) & Co, Mica Merchants, 2, Fenct, Fenchurch-st, London, E.C.

Davis, Edward P., Electrician, 149, Finchley-rd, London, N.

Davis, Frederick, F.S.A., Electrical Engineer, Palace-chmbrs, 9, Bridge-st, Westminster, London, S.W. (*Excalibur London*)

Davis, Gabriel, Manufacturing Electrician and Electrical Engineer, St. Helen's Wharf, Thames Wharf, Abingdon

Davis, George Frederick, Electric Bell Manufacturer, 185, Vauxhall Bridge-rd, London, S.W.

Davis, Geo. James, Electrical Engineer, Overton, Ormeley-rd, Balham, London, S.W.

Davis, H., Electrician, 21, Kidderminster-rd, Croydon

Davis (J.) & Co, Telegraph Engineers and Electrical Apparatus and Lightning Conductor Makers, 51, Tyrell-st, Bradford, Yorkshire. (*Davis Electrician Bradford*)

DAVIS (J.) & SON, Electric Light and Power Engineers, Manufacturers of Colliery Electric Plants, Electric Lamp Protector Fittings, Art Fittings, &c., All Saints Works, Derby; and 118, Newgate-street, London, E.C. (*Davis Derby*)

Davis (J. H.) & Co, Consulting and Manufacturing Engineers, 3, Salter's Hall-court, Cannon-st, London, E.C. (*Faith London*)

Davis, Joseph, Electrical Engineer, 6, Kennington Park-rd, London, S.E.

DAVIS, L. K., Consulting and Contracting Engineer, 1, Broadway, New York, U.S.A. **See Advt.**

Davis & Soper, Agents to the Johannesburg Lighting Company, Limited, and the Cape Town and Suburban Electric Lighting Syndicate, Limited, 6, Great Winchester-st, London, E.C. (*Reposnos London, 4481*)

Davis, T., Electrician, 20, Alexandra-rd, Hill, Southampton

Davis & Timmins, Limited, Screw and Terminal Manufacturers, 34A, York-rd, King's Cross, N., and 28, Hatton-gdn, E.C., London. (*Conductivity London*)

See also page 281.

Davison, Alex., Electrician, 47, London-st, Glasgow

Davy Bros, Limited, Engineers and Boiler Makers, Park Iron Works, Sheffield. (*Motor Sheffield*)

Dawbarn, R. A., Electrical Engineer, 49, Queen Victoria-st, E.C., and 54, Cromford-rd, Wandsworth, S.W., London

Dawkins, W. A., Manufacturing Electrician, 8, Warstone-parade East, Birmingham

Dawnay, Archibald Davis, Consulting Engineer, 40A, King William-st, London, E.C. (*Dawnay London*)

Dawson, Bernard, Consulting Engineer, 110, Cannon-st, London, E.C. (*Crocus London*)

Dawson, Hammond & Co, Electrical Engineers, 4a, John-st West, Edgware-rd, London, W.

Dawson, Philip, Electrical Engineer, c/o R. W. Blackwell, 39, Victoria-st, London, S.W.

Dawson, Roger, Limited, Electric Light Engineers and Contractors, 53, Berners-st, W., and (Factory) Art Metal Works, Stanhope-st, Euston-rd, London, N.W.

See also page 281.

Day, Arthur, A.I.E.E., Electrical Engineer, St. Osyth, Kidderminster-rd, West Croydon

Day, Charles F., Electric Bell Manufacturer, 110, High-st, Stoke Newington, London, N.

Day, Charles, jun, Wire Drawer, 8, Nelson-ter, City-rd, London, N.

Day, Joseph, Electrical Engineer, Compton-villa, Paragon-rd, Weston-super-Mare

Day, Gerald St. John, Electrical Engineer, 53, Union-st West, Oldham

Day's Gas Engine Co, Ltd.—*in liquidation*

De Pass, E., Chartered Patent Agent, 78, Fleet-st, London, E.C.

Deakin, B., Resident Electrical Engineer, City of London Electric Light Co's Generating Station, 64, Bankside, London, S.E.

Dean, A., Experimental Glass Blower, 73, Hatton-garden, London, E.C.

Dean, T., Telegraph Cable Machine Manufacturer, East Surrey Foundry, Pitlake, Croydon

Dearlove, Arthur L., Electrical Engineer, 4, Great Winchester-st, London, E.C.

Deeks, Stevens & Hellis, Electrical Engineers, 18, Bishop's-rd, London, W.

Deeley, F. Heath, Electrical Engineer, 6, Carlton House-ter, London, S.W.

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Defries (J.) & Sons, Limited, Makers of Electric Light Apparatus, 147, Houndsditch, E.C., and 1, 2, 3 and 6, Gravel-lane, E., London (*Defries London, 4327*)

De Lattre, Alfred L., Telegraph Engineer, Engineer's Department, General Post Office, London, E.C

DELAWARE HARD FIBRE COMPANY, Manufacturers of Electrical Insulating Material, Wilmington, Del., U.S.A.; and 15, Long-lane, London, E.C. (J. Burns, General European Agent). **See Advt., p. 576**

Dell, Holland, Electrician, The Hermitage, 51, St. James-rd, Upper Tooting, London, S.W.

Dell (W. R.) & Son, Turbine Importers, 26, Mark-lane, London, E.C. (*2275*); and West Croydon (*9304*). (*Cosgrove London*)

DELLAGANA (B.) & CO, Limited (George E. Holloway, Manager), Fine Art Electrotypers and Stereotypers and Photo-Zincographers, 106 and 107, Shoe-lane (*2960*), 48, Fetter-lane, and 14, Bishopsgate-avenue, Camomile-st, E.C., and 10, Gayton-road, Hampstead, N.W. (*7675*), London; and at 61-62A, Greengate, Salford, Manchester, and 35, Atherton-st, Liverpool. **See Advt., p. 14.**

Delta Metal Company, Limited, 110, Cannon-st, E.C. (*11292*), and 29, Pomeroy-st, New Cross-rd, S.E. (*4566*), London. (*Delta London*)

Dempster, Albert M., Electrical Engineer, 6, Coleridge-st, Halifax, Yorks

Dempster, Moore & Co, Steam Engine Indicator and Gauge Makers, 49, Robertson-st, and 41, York-st, Glasgow; and 60, Queen Victoria-st, London, E.C. (*Dempster Glasgow, 505*)

Denison Auto-Telegraph Machine Syndicate, Limited, Telegraph Engineers, 2, Ovington-sq, London, S.W.

Denison (Samuel) & Son, Testing Machine Makers, Old Grammar School Foundry, Leeds. (*Weigh Leeds*)

Dennis, T. H. P., Electrical Engineer and Contractor, Chelmsford, Essex (*Gheber Chelmsford*)

DENNIS (W. F.) & CO (Agents for Messrs. Felten and Guilleaume), Iron and Steel Wire, Wire Ropes, Telegraph and Telephone Cables, Lightning Conductors, &c., Makers, 11, Billiter-st, London, E.C. (*Fredennis London, 4350*) **See Advt., p. 9.**

Denny, A., Electrical Engineer, Wm. Denny & Bros, Leven Ship Yard, Dumbarton

Denny (Wm.) & Bros, Electrical Engineers and Shipbuilders, Dumbarton (*Leven Dumbarton, 1* and *15*); and 36, Walbrook, London, E.C. (*1885*)

Dent (E.) & Co, Makers of Non-Magnetisable Watches, 61, Strand, W.C., 4, Royal Exchange, E.C., and 4, Hanway-pl. W., London

Derby & Co, Platinum Buyers, 44, Clerkenwell-rd, London, E.C.

Dering, George E., Electrician, Lockleys, Welwyn, Herts.

Dermatine Company, Limited, Dermatine and India Rubber Manufacturers, 95, Neate-st, Camberwell, London, S.E. (John Cooper, Managing Director) (*Dermatine London*)

Dernier (Louis) & Co, Makers of Electric Light Shades, 78, Newman-st, London, W. (*Prettiness London*)

Desmoutis (F.), Lemaire & Co, Platinum Refiners, 247, Tottenham Court-rd, London W. (*Palladium London*)

Devey, Arthur Chas., Electrician, 6, Mincing-lane, London, E.C.

Devonshire, J., Secretary. Laing, Wharton and Down Construction Syndicate, Limited, 38, Parliament-st, London, S.W.

Dew, J. A., Electrical Engineer, Carey-st, Reading

Dew, W. Elsden, A.I.E.E., Electrical Engineer, Messrs. Sharp & Kent, 34, Victoria-st, S.W., and 65, Bournemouth-rd, Rye-lane, Peckham, S.E., London

*Dewar, Prof. J., M.A., F.R.S., Professor of Chemistry at the Royal Institution, 21, Albemarle-st, London, W.

Dewhurst, Edward, Electrical Engineer, 89, Fishergate, Preston; and at 10, Talbot-chmbrs, Blackpool. (*Dewhurst Electrician Preston, 81*)

Dewrance & Co, Anti-Friction Metal, White Metal, and Asbestos-Packed Steam Fittings Manufacturers, 158, Great Dover-st, London, S.E. (*Dewrance London*)

DIAGO'S INTERNATIONAL PROTECTION AGENCY, Havana, Cuba. **See Advt., p. 496**

Dick, Alexander, Delta Metal Merchant and Exporter, 110, Cannon-st, London, E.C. (*Delta London, 11292*)

Dick, Kerr & Co, Limited, Makers of Double-Acting Gas Engines, 101, Leadenhall-st, E.C. (*Dicker London, 4508*)

See also page 281.

Dick, R. & J., Gutta Percha Manufacturers, Greenhead (*2544*), and 153, Argyle-st, Glasgow (*3327*) (*Gutta Percha Glasgow*)

Dickens, E., Secretary to the Telegraph Construction and Maintenance Company, Limited, 38, Old Broad-st, London, E.C.

Dickenson, Alfred, Civil and Electrical Engineer, Darlaston, Staffordshire; General Manager South Staffordshire Tramway Company, Mechanical Engineer to the Birmingham Central Tramways, and Manager of the Tramway Department of the Electric Construction Company, Limited

Dickinson, F. W., Electrical Engineer and Contractor, St. Ann's Electrical Works, Cross and Upper Fountaine-streets, Leeds (*Electric Leeds, 1204*)

Dickinson, Harold, Electrical Engineer, Yorkshire House-to-House Electricity Supply Company's Central Station, Leeds

Dickinson, Herbert Young, Engineer, 56, Gray's Inn-rd, London, W.C. (*Dickinson c/o Neapolitan London, 2925*)

Dickinson, W., Electrician, Northcote-villa, Spring-grove, Isleworth

Dick's Asbestos Company, Asbestos Manufacturers, 2 and 4, Trinity-st, Canning Town, London, E. (*Eagle London, 5241*)

Dickson & Head, Lead and Glass Merchants, 80, 81, and 82, St. George-st, and 3, Ratcliff-st, London, E. (*2454*)

Dickson & Mann, Limited, Engineers and Steel Founders, Bathville Steel Works, Armadale Station, Linlithgowshire (*Mann Armadale*)

DICKSON, JAMES, Maker of the Patent "Tieciton" Dynamo Brush, 48, Gray's Inn-rd, London, W.C. **See Advt., p. 468.**

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Dickson (John) & Co, Engineers, Machinery and Asbestos Merchants, 5, Laurence Pountney-hill, London, E.C.

Dieselhorst, Wilhelm, Electrician, Messrs. Siemens Bros. & Co, Limited, Woolwich, Kent

Dietz, Davis & Co, Limited, Electrolier, Lamp and Lustre Manufacturers, 44, Upper East Smithfield, London, E.

Dillon, Thomas, Glass Blower, 364, Gray's Inn-rd, London, W.C.

Dimier, Paul, Electrical Engineer, 5, Hyde Vale-villas, Blackheath, London, S.E.

Dimmock (John) & Co, Makers of Porcelain for Electrical Purposes, Albion Works, Hanley

Dingle, W. H., Electrician, 13, Hindon-st, Pimlico, London, S.W.

DIRECT SPANISH TELEGRAPH COMPANY, Limited, 280, Winchester House, Old Broad-st, London. Stations: 74, Gracechurch-st, and 280, Winchester House, Old Broad-st, E.C., and Foreign Auction Hall, Covent Garden Market, W.C., London

Sir John Pender, G.C.M.G., M.P., Chairman
Charles Gerhardi ... ... Manager
See also page 281.

DIRECT UNITED STATES CABLE COMPANY, Limited, Winchester House, Old Broad-st, London, E.C. Head Stations: 39, Mark-lane, London, E.C. (*1384*); D 6, Exchange-bldgs, Liverpool; the Queen-bldgs, Hollis-st, Halifax, Nova Scotia; Old State House, State-st, Boston, Mass.; 40, Broadway, 444, Broome-st, and 21½, Spruce-st, New York. Branch Stations: 34, Throgmorton-st, E.C., South Sea House (adjoining the "Baltic"), Threadneedle-st, E.C., East India-avenue, Leadenhall-st, E.C., the Commercial Sale Rooms, Mincing-lane, E.C., London; Back Hall-chmbrs, Baldwin-st, Bristol; and 40, Hope-st, Glasgow (*3126*) (*Direct London; Direct Liverpool; Direct Glasgow*). **See Advt., p. cxxviii.**

Sir John Pender, G.C.M.G., M.P. ... ... } Chairman
T. Finnis ... ... Secretary
O. Moll ... ... Traffic Manager
See also page 281.

District Messenger Service and News Company, Limited, 50, and 51, Lime-st, London, E.C. (*11129*)

Charles T. Russell ... General Manager
A. Lord ... ... Secretary
See also page 281.

District Messenger Company of Paris, Limited, 23, Leadenhall-st, London, E.C.

Chas. T. Russell ... ... Managing Director.
George Macmuldrow ... Secretary (*pro tem.*)

Dix, G. R., Electric Light Engineer and Contractor, 124, St. John-street-rd, London, E.C.

Dixon & Corbitt and R. S. Newall & Co, Limited Lightning Conductor Makers, 30, Great St, Helen's, E.C. (*4072*), 130, Strand, W.C. (*2705*), and 73, Garford-st, West India Dock-rd, E., London (*5051*); and at Gateshead-on-Tyne, Glasgow (*3120*), and Cardiff. (*Corbitt London; Dixon Gateshead; Wire-rope Glasgow; Fathom Cardiff*)

Dixon, George, Agent for Gent & Co, 47, Highbridge, Newcastle-on-Tyne

Dixon (I.) & Co, Makers of Galvanised and Corrugated Iron and Steel Sheets, Roofs, Sheds, Houses and Buildings for all purposes, Windsor Iron Works, Spekeland-rd, Liverpool (*Roofing Liverpool, 1054*)

Dixon (James) & Sons, Silver and Nickel Electro Platers, Cornish-pl, Sheffield; and 14, St. Andrew-st, London, E.C. (*Dixon Sheffield; James Dixon London*)

Dixon, J. R., Electrical Engineer, Keswick Electric Light Company, Stanley-ter, Blencathra-rd, Keswick

Dixon (S.) & Son, Manufacturers of Electric Light Fittings, Boar-lane, Leeds (*981*); Works, Swinegate (*197*). (*Brass Leeds*)

Dixon (Walter) and Co, Electrical and General Engineers, 164, St. Vincent-st, Glasgow (*Esco Glasgow, 3656*)

Dobbie, Thomas, Jun, Electrical Engineer, 58, Pollock-st, Glasgow

Dobie, John, Maker of Engineers' Tools, 205, Argyle-st, Glasgow

Dobson & Co, Electrical Engineers & Contractors, 37, Sloane-sq, Chelsea, London, S.W.

Dobson, R. & H., Electrical Engineers and Contractors, 14, Sackville-st, Salford

*Dobson, Sydney T., Chief Engineer to the St. James's and Pall Mall Electric Light Company, Limited, Carnaby-st, Golden-sq, W., and Mason's-yard, Duke-st, St. James's London, S.W. (*Licensable London, 35082*)

Dodman, A., Electrical Engineer and Boiler Maker, Highgate Foundry, King's Lynn. (*Dodman Lynn*)

Dods (D.) & Co, Electrical Engineers and Electricians, Murphy-st, Oakley-st, Lambeth, London, S.E.

Dodson, John, Electric Light Engineer and Contractor, 29, Fetter-lane, London, E.C.

D'Odiardi, E. S., Electrician, 43, Cornwall-gdns, London, S.W.

Doherty, John, Telegraph Engineer, Postal Telegraphs, Manchester

Dolby, E. R., Consulting Electrical Engineer 8, Princes-st, Westminster, London, S.W.

Dollander, Robert, Electrical Engineer, 3, York-pl, Halliwell-lane, Cheetham, Manchester. (Sole resident member in Great Britain of the firm of Fabius Henrion, of Nancy, France)

Dollond & Co, Scientific Instrument Makers 35, Ludgate-hill, and 62, Old Broad-st, E.C., and 5, Northumberland-avenue, W.C., London

Domeier & Co, Platinum Refiners, &c., 13, St, Mary-at-Hill, London, E.C.

Domestic Telephone Company, Limited, 24, Fulham-rd, London, S.W. (J. R. Gibson, Secretary)

Dominion Electrical Company, Limited, Electrical Engineers and Contractors, 85, Queen Victoria-st, London, E.C.

Donald (James T.) & Co, Makers of the Premier Gas Engine, 345, Argyle-st, Glasgow. (*Mechanikos Glasgow, 3066* and *4400*)

Donkin (Bryan) & Co, Limited, Engineers, 55, Southwark Park-rd, London, S.E. (*Donkin Company London, 4662*)

Donne, F. M., Electrician, 3, Gloucester-ter, Hyde Park, London, W.

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Donnison, Parmiter & Barber, Electrical and Mechanical Engineers, 20, Wormwood-st, London, E.C; and at Manchester and Southampton. (*Transformer Manchester*)

Donovan, Edward W., Mechanical and Electrical Engineer, Messrs. J. S. Leach & Co, Mount-st Works, Harpurhey, Manchester

Donovan, H. C., Electrical Engineer, Fairfield, Mycenæ-rd, Westcombe Park, London, S.E.

Doolin, Walter G., B.E., M.A., Consulting Engineer, 20, Ely-pl, Dublin

Dorman, Long & Co, Limited, Steel and Iron Manufacturers, Middlesbrough (*Dorman Middlesbrough*); and at 19, Victoria-st, and Nine Elms-lane, London, S.W. (*3154*)

DORMAN & SMITH, Electrical Engineers and Electricians, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocer's Hall-ct, London, E.C. (*Current Manchester; Prefix London*) **See Advt., p. 11.**

Dorman, A. H., Electrical Engineer, Manager of the London Office of Messrs. Dorman and Smith, 11, Grocer's Hall-ct, London, E.C. (*Prefix London*)

Dorman, C. M., M.I.E.E., Electrical Engineer, Dorman & Smith, Ordsal Station Electrical Works, Salford, Manchester

Doubleday, Villeroy C., Electrician, Electric Cycle Syndicate, Limited, 37, Walbrook, London, E.C.

Doublet, T. & H., Scientific Instrument Makers, 11, Moorgate-st, London, E.C.

Dougall, W. S., Manufacturer of Dougall's Patent Papier-Maché Covering for Pulleys, Radcliffe-on-Trent, Notts. (*Dougall Radcliffe-on-Trent*)

Doughty, E., Electrician, Foxhall-rd, The Forest, Nottingham

Dougill, Alfred, Limited, Electric Bell and Gas Engine Manufacturers, 34, 36 and 54, Great George-st, Leeds

Douglas & Laxey Coast Electric Tramway, Limited, Douglas, Isle of Man. (J. Aldworth, Manager; F. Saunderson, C.E., Engineer)

Douglas, Robert Charles, Consulting Electrical Engineer, 1, Cunliffe-villas, Manningham, Bradford, Yorks.

Douglas, W., Electrical and Telephone Engineer, 63, York-pl, Edinburgh. (*1037*)

Douglass, Archibald, Electrician, Wardrobe-chmbrs, Queen Victoria-st, London, E.C.

Douglass, Sir Jas. N., F.R.S., M.Inst.C.E., &c., Stella House, Dulwich, London, S.E.

Douglass, Wm. T., Consulting Lighthouse Engineer, 17, Victoria-st, London, S.W.

DOULTON & CO, Manufacturers of Stoneware and Porcelain for Electrical Purposes, and of the Patent Stoneware Electrical Conduit, Lambeth Pottery, London, S.E.; also at Rowley Regis, Staffs.; Smethwick, near Birmingham; St. Helen's, Lancs.; and at Birmingham, Liverpool, Manchester, and Paris. (*Doulton London, 4621*) **See Advt., p. 579.**

Doulton & Co, Earthenware Telegraphic Appliances Manufacturers, Burslem, Staffs.; and 14, St. Andrew-st, Holborn-circus, London, E.C. (*Doultons Burslem*)

Dover Electricity Supply Company, Limited, 49, Queen Victoria-st, London, E.C.
Sir Wm. Crundall ... Chairman
A. J. Lawson ... ... Engineer & Manager
B. Broadhurst ... ... Secretary

Dowie & Handyside, Limited, Engineers, 22, Booth-st, Manchester

*Down, F. J., Electrical Engineer (Messrs. Laing, Wharton & Down), 82A, New Bond-st, W. (*3602*), and 28, Victoria-rd, Old Charlton, S.E., London

Downe, Reginald Sydney, Electrical Engineer, National Electric Supply Company, Limited, 119A, Fishergate, Preston, Lancs.

Downham (John) & Co, Engineers, Barnbrook Iron Works, Bury (*Barnbrook Bury, 31*)

Dowsing, H. J., Electrical Engineer (Messrs. Crompton & Co, Limited), Mansion House-bldgs, E.C., and Manager of Show Rooms 148, Brompton-rd, S.W., London. (*8530*)

Dowson Economic Gas and Power Company, Limited, Makers of Gas Producers for Gas Engines, &c., 3, Great Queen-st, Westminster, London, S.W. (*Gascous London*)

Dowson, J. Emerson, Electrician, Dowson Economic Gas & Power Company, Limited, 3, Great Queen-st, Westminster, London, S.W.

Drake, Bernard, Electrical Engineer, 66, Victoria-st, Westminster (*3071*), and "The Gables," Mitcham, London, S.W. (*9371*)

DRAKE & GORHAM, Electrical Engineers, 66, Victoria-st, London, S.W. (*Accumulator London, 3071*) **See Advt., p. 15**

Draper, George, Secretary of the Eastern Telegraph Company, Limited, the Eastern and South African Telegraph Company, Limited, and the Black Sea Telegraph Company, Limited, Winchester House, Old Broad-st, London, E.C. (*Draper London, 1259*)

Drennan, W. H., Electrical Engineer, 44, Mount Charles-avenue, Belfast

Drew & Cadman, Exhibition and Show Case Makers, 245, High Holborn, London, W.C.

Drew, J W., Electrician, 20, St. Petersburg-pl, Bayswater, London, W.

Drewery, W., Dealer in Electrical Supplies, Oak-st, South Bank, Yorks.

Dring & Fage, Electrical and Scientific Instrument Makers, 145, Strand, London, W.C.

Driver, Geo., Telegraph Apparatus Maker, 210, Euston-rd, London, N.W.

Dronfield Malleable Casting Company, Malleable Iron Founders, Dronfield, near Sheffield. (*Casting Company Dronfield*)

Druce, William H., Electrical Engineer, Messrs. Benne t and Druce, 44, Fishergate, Preston. (*Consult Preston, 182*)

Drum Engineering Company, Limited, Hydraulic and Pneumatic Engineers, 35, Athol-rd. Bradford. (*Drum Bradford*)

Drummond, R. H. Tudor, Electrician, 49, Norroy-rd, Putney, London, S.W.

Drury Bros, Electrical Engineers, London-st and Chapel-pl, Kingston, Surrey

Drury, W. W., Electrical Instrument Maker, Shrewsbury-rd, Harlesden, London, N.W.

Drysdale & Co, Electricians and Engineers, Bon Accord Engine Works, 183, Fordneuk-st, Glasgow; and 34, Queen-st, London, E.C. (*Bon Accord Glasgow*)

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Dublin Museum of Science and Art, Dublin.
(*For Officials, see p. 232*)
Duckenfield (E.) & Son, Electric Light Engineers and Contractors, 31, Gold-st, Northampton
Duckham, Heber, Pneumatic Engineer, 2, Royal Exchange-bldgs, London, E.C.
Ducloy, Jacques F., Superintendent Government Cables, Central Telegraph Office, St. Martin's-le-Grand, London, E.C.
Dudgeon, A. & W., Engineers and Shipbuilders, 112, Fenchurch-st, London, E.C.
Dudley, Guildford, Electrician, Eastern Telegraph Co, 50, Old Broad-st, London, E.C.
Dugdill (E. J.) & Co, Electrical Engineers, Failsworth, near Manchester. (*Dugdills Electricians Failsworth*)
Duke, James, Electric Bell Fitter, 4, Bethlehem-st, Great Grimsby
Dumbrell, J. A., Electrician, 24, Park Hill-gdns, Sydenham, London, S.E.
Duncan, R., Consulting Electrician, Crowthorne, Berks.
Duncan Bros., Consulting Engineers, 28, Victoria-st, London, S.W. (*Doucine London*)
Duncan Wallet & Co—*see* Wallet (Duncan) & Co.
Dundas, T. Duncan, Electrical Engineer, 3, Peter's-ct, St. Martin's-lane, W.C., and 78, Cambridge-gdns, Notting Hill, W., London
Dunkley, G. W., Electrician, Downley, Ditcham Park, Petersfield
Dunlop (F. W.) & Co, Electrical Engineers and Contractors, 26, Coventry-st, London, W.
Dunn, Andrew S., Telegraph Engineer and Superintendent Caledonian Railway, 25, Killermont-st, Glasgow
Dunn, G. B., Electrical Engineer, Central Electric Light Station, 10, Sardinia-st, London, W.C.
Dunn, Walter T., Secretary of the Junior Engineering Society, 47, Fentiman-rd, London, S.W.
Dunning, R. H., Electrical Agent, 7, King's-rd, Windsor
Dunscombe, Clement, Consulting, Civil and Municipal Engineer, 32, Victoria-st, London, S.W. (*Persuade London*)
Dunscombe, M. W., Optician, and Maker of Electrical and Chemical Apparatus, 10, St. Augustine's-parade, Bristol
Dunsmuir and Jackson, Engineers and Boiler Makers, Govan Engine Works, Glasgow
Dupré, Auguste, Ph.D., F.R.S., F.C.S., Analytical Chemist, Westminster Hospital, Caxton-st, London, S.W.
Durham College of Science, Newcastle-on-Tyne. (*For list of Professors, see page 269*)
Durnford, Chas. W., Electrician, 8, The Avenue, Blackheath, London, S.E.
Durrant, A. T., Electrical Engineer, 4, Queen-st, Great Yarmouth
Durston, A. J., Engineer-in-Charge, Engineering Branch, Controller's Department, Admiralty, Spring-gdns, London, S.W.
Durtnall, W., Electrical Engineer, Cannon-street Hotel, Cannon-st, London, E.C.
Dussek Bros & Co (late Dussek, A. L.), Creosote Manufacturers, Verney-rd, Old Kent-rd, London, S.E. (*Dussek London, 4838*)
Düsseldorfer Eisen und Draht Industrie, Wire Makers, 6, Lime-st, London, E.C. (Schwarte & Hammer, Agents)
Duthy, J. W. B., M.I.E.E., Electrician, Cronberg, Arterberry-rd, Wimbledon
Dutton & Co, Limited, Electric Signal Manufacturers, Railway Signal Works, Worcester; and 70 and 71, Palace-chambers, Westminster, London, S.W. (J. P. O'Donnell, Agent.) (*Duttons Worcester; O'Donnell London, 3059*)
See also page 281.
Dyer, Bernard, B.Sc., F.I.C., F.C.S., Analytical Chemist, 17, Great Tower-st, London, E.C.
Dyer, John, Electrical Engineer, Messrs. B. Verity & Sons, King-st, Covent-grdn, London, W.C.
Dyer, W. H., Electrician, 116, St. John Street-rd, London, E.C.
Dykes, A. H., Electrician, 23, Holmesdale-rd, Bromley, Kent

— E —

Eadie (J.) & Sons, Tube Makers, Clydesdale Tube Works, Rutherglen, near Glasgow; and 110, Cannon-st, London, E.C. (*Eadie Rutherglen*)
Eadon (Moses) & Sons, Engineers' and Tool Makers, President Works, Sheffield; Buckingham-st, Birmingham; and 55 and 56, Bishopsgate-street Within, London, E.C. (*Eadon Sheffield, 37; Eadon Birmingham, 696; Enodator London*)
Eagar, H. T., Electrician, 31, St. Dunstan-st, Canterbury
Eagland, Joseph, Scientific Instrument Maker, 152, Farringdon-rd, London, W.C.
Eagle Engineering Company, Limited, Makers of the Eagle Oil Engine, Guardian-bldgs, Manchester
Earl & Philp, Electric Light Engineers 113, London-wall, and 32, Bartholomew-close, London, E.C.
Earle, Bourne & Co, Metal Workers, Birmingham Tube Works and Rolling Mills, Heath-st South, Spring-hill, Birmingham. (*Tubing Birmingham*)
Earle, C. W., Chairman West India and Panama Telegraph Company, Limited, Dashwood House, New Broad-st, London, E.C.
Earle, Hardman A., M.I.E.E., Electrical Engineers, 16, Victoria-st, Westminster, London, S.W.; and Chloride Electrical Storage Syndicate, Limited, 8, King-st, Manchester
East Coast Engineering Company, Limited, Electrical and Mechanical Engineers, Battery Green-rd, Lowestoft. (R. B. Capps, Secretary).
East Ferry Road Engineering Works Company, Limited, Makers of Engines, Boilers, and Cranes, 118, East Ferry-rd, Millwall, London, E. (*Hydrostatic London, 5202*)
East, G. E., Manufacturer of Electrical Supplies, 66, Victoria-st, London, S.W.
Eastbourne Electric Light Company, Limited, Grove-rd-chambers, Eastbourne. Works: Central Station, Junction-rd, Eastbourne
George Boulton ... Chairman
H. W. Wilkinson ... Engineer and Manager
H. Towner ... ... Secretary
See also page 281

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EASTERN TELEGRAPH COMPANY, Limited, Winchester House, Old Broad-st, London, E.C. (*Eastern London, 1259*). Stations: 206A, Winchester House, 11, Old Broad-st (*1278*), 8, Leadenhall-st, 3, Great Tower-st, and 37, Holborn-viaduct, E.C.; 449, Strand, and 5, Foreign Auction Hall, Covent-garden, W.C.; 41 and 42, Parliament-st, S.W., London; K 13, Exchange-buildings, Liverpool; 20, Brown-st, Manchester; and 3 and 5, Royal Bank-pl, Glasgow. **See Advts., pp. cxviii. to cxxiii.**

Sir John Pender, G.C.M.G., M.P. Chairman
J. Denison Pender .. ... Man. Dir.
H. A. C. Saunders .. ... Chief Electrician
George Draper ... ... Secretary

See also page 282

EASTERN AND SOUTH AFRICAN TELEGRAPH COMPANY, Limited, Winchester House, Old Broad-st, London, E.C. **See Advts., pp. cxix., cxxiv. and cxxv.**

Sir John Pender, G.C.M.G., M.P. Chairman
J. Denison Pender ... ... Man. Dir.
George Draper ... ... Secretary

See also page 282

EASTERN EXTENSION, AUSTRALASIA AND CHINA TELEGRAPH COMPANY, Limited, Winchester House, Old Broad-st, London, E.C. (*Occidental London, 1107*) **See Advt., p. cxix.**

Sir John Pender, G.C.M.G., M.P. Chairman
F. E. Hesse ... ... Secretary

See also page 282

Easton & Bessemer, Limited, Engineers and Makers of High-Speed Engines for Electric Lighting, Taunton. (*Eastwald Taunton*)

Easton (Edward) & Co, Consulting Engineers, 11, Delahay-st, Westminster, London, S.W. (*3049*)

EASTON & ANDERSON, Limited, Electrical and General Engineers, &c., 3, Whitehall-pl, London, S.W. (*Egyptian London, 3695*); and Erith Iron Works, Erith, Kent (*Eastons Erith, 8410*). **See Advt., p. 516.**

T. P. Wilson ... . Chairman
J. M. Hamilton ... ... Secretary

See also page 282.

Eaton (Samuel) & Sons, Manufacturers of Electric Light Fittings, Barr-st, St. George's, Birmingham

Eaton, H., Superintending Engineer, London District Postal Telegraphs, Mount Pleasant, London, E.C.

Ebbsmith, Joseph, Chairman of the British Electro-Chemical Agency, Limited, Director of the Phosphorus Company, Limited, and of the Oxford Electric Company, Limited, 86, St. James's-st, London, S.W.

Ebel, Julius, Electrical Engineer, Julia Cottage, Charlton-lane, New Charlton, London, S.E.

Eburite Art Company, Makers of Silk and Paper Lamp Shades and Dealers in Mica, 75 and 76, High Holborn, London, W.C.

Eccles, E. S., Electrician, 3, Holyrood-ter, The Hoe, Plymouth

Echevarri, J. T. W., Electro-Metallurgist, Manager of the Cowles Syndicate Company, Limited, Milton Works, Milton, near Stoke-on-Trent

Eck, Justus, M.A., M.I.E.E., Electrical Engineer, c/o Laing, Wharton & Down, 82A, New Bond-st, London, and 13, Burnaby-gdns, Chiswick, W.

Economic Electric Supply Company, Electrical Apparatus Makers, 397, Edgware-rd, London, N.W.

Economic Gold Extraction Company, Limited (Chemical and Electrical), 576, Mansion House-chambers, 20, Bucklersbury, London, E.C. (*Performed London*)

William Strapp... ... ... Chairman
H. A. Moseley ... ... Secretary

Economic Telephone and Electric Supply Company, 58, North-corridor, Royal Exchange, Manchester

Ecuador Telephone Company, Limited, 42, Old Broad-st, London, E.C. (*Chiliadal London*)

T. Greenwood ... ... Chairman
Edmund Petley ... . Secretary

See also page 282.

Eddington, William, Manufacturer of Lubricating Oils and Grease, 17 and 18, Railway Approach, London Bridge, London, S.E.

Eden, Augustus, Technical Officer and Assistant Electrician, Engineer-in-Chief's Department, G.P.O., London, E.C.

Edey, G., Dealer in old Platinum, &c., 16, Medwin-st, Brixton, London, S.W.

Edgar, James, Electrical Engineer, Milton Villa, Wrexham

Edgcome, J. E., Resident Electrical Engineer and Manager, Central Electric Light Station, Richmond, Surrey

Edison-Bell Phonograph Corporation, Limited, Edison House, Northumberland-av, London, W.C.; 145, Queen-st, Glasgow: and at Manchester. (*Graphophone London, 35057*)

W. Alex. Smith... ... ... Chairman
W. M. Crowe ... ... Secretary

Edison-Gower-Bell Telephone Company of Europe, Limited, 53, New Broad-st, E.C.

Sir A. Armstrong, K.C.B. ... Chairman
R. Rodgers ... ... Secretary

See also page 282.

EDISON AND SWAN UNITED ELECTRIC LIGHT COMPANY, Limited, 100, Victoria-st (*Ediswan London, 3146*), 50, Parliament-st (*3085*), S.W., and 110, Cannon-st, E.C. (*15053*), London; 134, Royal-avenue, Belfast: 14 and 16, Martineau-st, Birmingham; 111, Bute Docks, Cardiff; 12, Dawson-st, Dublin; 17, Castle-st, Dundee; 153, West George-st, Glasgow; 1, Grosvenor-bldgs, Carr-lane, Hull; 127, Albion-st, Leeds; 6, Tower-gdns, Water-st, Liverpool; 2 to 8, Pilgrim-st, Newcastle-on-Tyne. Works: Ponder's End (*Ediswan Ponders End*) and South Benwell, Newcastle-on-Tyne. **See Advts., pp. 453, 484, 524, 547, 570, and 572**

J. Staats Forbes... ... Chairman
Major S. Flood Page... Deputy-Chairman
H. Charles Gover ... Secretary

See also page 282.

Edison United Phonograph Company, Limited (S. F. Moriarty), Edison House, Northumberland-avenue, London, W.C. (For Europe, Asia, Africa and Australia). (*Phonograph, London, 3200*)

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EDMONDSON, JOSEPH, Sole Maker of the Oulton-Edmondson Electricity Meter, Albert Electrical Works, Hey-st, Longside-lane, Bradford. (*Electrometer Bradford*)

*Edmunds, Henry, Consulting Electrical Engineer, Albany-bldgs, 39, Victoria-st (*3191*), and Antron, 71, Upper Tulse Hill (*9142*), London, S.W. (*Phonoscope London*)

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See also page 282.

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See also page 282.

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See also page 284.

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See also page 283.

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See also page 283.

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J. Cecil Bull ... ... Secretary

See also page 283.

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See also page 283.

Electric Lighting and General Development Syndicate, Limited, Electric Light Engineers, 5, Queen Victoria-st, London, E.C.

See also page 283.

ELECTRIC LIGHTING NOTICES for 1894—*see p. 161.*

Electric Light Regulating Syndicate, Limited, Electrical and Mechanical Engineers, c/o Adrian C. Collins, 61, Old Broad-st, London, E.C.

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See also page 283.

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ELECTRIC TRACTION NOTICES for 1894—*see p. 161.*

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See also page 283

Electric Trust, Limited, 17, Parliament-st, Westminster, London, S.W.

See also page 283.

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See also page 283.

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See also page 283.

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See also page 284.

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See also page 284.

ELECTRICAL COMPANY, Limited, Electrical and Mechanical Engineers, 122 & 124, Charing Cross-rd, London, W.C. (Sole Representatives in Great Britain of the Allgemeine Elektricitäts Gesellschaft of Berlin, late the German Edison Company.) (*Galvanoscope London, 35028*). **See Advt., p. 539**

See also page 284.

Electrical Engineering Company of Ireland, Limited—*in liquidation.* (D. M. Kean, 46, Dame-st, Dublin, Liquidator)

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Electrical Engineers, Journal of the Institution of (published irregularly) (Messrs. E. & F. N. Spon, 125, Strand, London, W.C.)

Electrical Engineers, Syndicate of, 15, St. Helen's-place, London, E.C. (P. A. Latham, Secretary)

ELECTRICAL EVENTS in 1893, Summary of—*see pages 61 to 65*

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See also page 283

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See also page 284

Electrical Inventions Company, Limited, 57, Moorgate-st, London, E.C.

See also page 330

Electrical Plant and Electrical Industry (monthly), 52, Queen Victoria-st, London, E.C. (Edited by H. Cuthbert Hall). Price 6d.

ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, E.C. (*338*), and Millwall, E. (*5116*), London (*Storage London*). **See Advt. on back cover**

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See also p. 284

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See also page 284

Electrical Review (weekly), 22, Paternoster-row, London, E.C. Price 4d. (*Ageckay London, 517*).

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See also page 285.

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E. W. Frazar }
Thomas A. Edison ... ... Cons. Elec. Eng.
T. Dundas Pillans ... ... Secretary

See also page 285.

Evans, C. J., Electric Bell Fitter, 80, Mildmay-park, London, N.

Evans, F. E., Superintending Engineer, Postal Telegraphs, Birmingham

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Evans, F. J., Electrician, Barry Railway Company, Barry, Cardiff

Evans, Geo. J., Brass, Ivory, &c., Turner, Monument Works, 105, Carver-st, Sheffield

Evans, Gordon & Co, Electric Light Engineers and Contractors, 47, Carnaby-st, Regent-st, London, W.

Evans-Jackson (J. E.) and Co, Patent Agents, 45, Holborn-viaduct, London, E.C. (*Jackfish London*)

Evans (Joseph) & Sons, Hydraulic Engineers and Metal Workers, Wolverhampton; and 16, Union-court, Old Broad-st., London, E.C. (*Evans Wolverhampton*)

Evans, Mortimer, M.I.C.E., F.G.S., Electrician, Savile Club, Piccadilly, London, W.

Evans & Widowfield, Dynamo Makers, 5, Bute-crescent, Cardiff

Evelyn-Liardet, J., Electrical and Hydraulic Engineer, 9, Bridge-st, Westminster, London, S.W.

Everall, J. B., Electrical Instrument Maker, 9, Ardoe-rd, Battersea, London, S.W.

EVERED & CO, Limited, Brass Manufacturers, and Electric Light Fittings Makers, 27 to 31, Drury-lane, W.C. (*Evered London, 2502*), 143, High-st, Shoreditch, E., 50 Holborn-viaduct, E.C., London; Surrey Works, Smethwick (*Evereds Birmingham*); and Barnet Works, Devonshire-st, Birmingham (*Romaine Birmingham*). **See Advt., p. 38**

R. B. Evered ... ... Chairman
D. Bartlett... ... ... Secretary

Everett, W. H., B.E., B.A., Electrical Engineer, 5, Shaftesbury-rd, Brighton

Everitt (Allen) & Sons, Limited, Manufacturers of Rolled Metals, Wires, and Tubing, Kingston Metal Works, Adderley-street, Birmingham; and 118, Cannon-st, London, E.C. (*Everitt Birmingham, 44*; *Sheathing London*)

Everling & Kaindler, General Engineers, 15, City-rd, London, E.C.

Evers, W. W., Electric Bellhanger, Sanitary Engineer, General and Electric Supplies for Amateurs, 15, West-st, Wath-upon-Dearne, near Rotherham

*Evershed, Sydney, Electrical Engineer, 1, Woodfield-rd, Harrow-rd, London, W.

Ewart & Son, Electrical Engineers and Fittings Manufacturers and Sheet Metal Workers, 346-350, Euston-rd, London, N.W. (*Geyser London*)

Ewen, C. H., Mechanical Engineer, 184, St. George-st, E., London. (*Multitubular London, 4028*)

Ewing (G. S.) & Co, Limited, Wire Manufacturers and Metal Merchants, 4, Red-cross-st, London, E.C.

*Ewing, Prof. J. A., M.A., B.Sc., F.R.S., F.R.S.E., M. Inst. C.E., Consulting Electrician and Electrical Engineer (Professor of Mechanism and Applied Mechanics, Cambridge University), Langdale Lodge, The Avenue, Cambridge

Excelsior Carbon Co, Makers of the "Excelsior" Wick Carbon, 80, Queen Victoria-st, London, E.C. (*See* Rheinische Fabrik für Elektrische Bogenlichtkohle W. Grudelbach in CONTINENTAL SECTION)

EXCHANGE TELEGRAPH COMPANY, Limited, 17 and 18, Cornhill, E.C. (*1141*), 64, Haymarket, S.W. (*3569*), Stock Exchange and 80, Fleet-st, E.C., and (Stores) 10, Devonshire-st, E., London.

Lord Sackville Cecil... Chairman
W. H. Davies ... Managing Director
W. King ... ... Secretary

See also page 285.

Exeter Electric Light Company, Limited, Rockfield Works, New North-rd, Exeter. (*Electric Light Exeter*)

W. Horton Ellis, J.P.... Chairman
H. D. Munro ... ... Electrician-in-charge
E. J. Rigby ... ... Secretary

See also page 285.

Expanded Metal Company, Limited, Metal Workers, 2, Dean's-yard, Westminster, London, S.W.

Exploration Company, Limited, 30, St. Swithin's-lane, London, E.C. (C. Quennell, Secretary.) (*Exarch London, 15017*)

Eymers, F. C., Electrician, 19, Upper Woodlander, Charlton, London, S.E.

Eyre & Spottiswoode, Mathematical Instrument Makers, &c., Great New-st, London, E.C. (*Spotless London, 2713*)

Eyre (Wm.) & Nephew, Iron and Metal Merchants, Galvanised Iron and Telegraph Wire Manufacturers, Manchester-bldgs, 1, Tithebarn-st, Liverpool. (*Eyre Liverpool, 1364*)

— F —

Fabris, V., Electrician, 18, Rathbone-pl, London, W.

Fagan (James) and Sons, Electric Bell Fitters, 18, Great Brunswick-st, Dublin

Fahie, Angelo, J.P., M.I.C.E., &c., Consulting Engineer and Electrician, 9, Westland-row, Dublin. (*Fahie Westlandrow Dublin*)

Fahie (J. K.) & Son, Consulting Electrical Engineers and Electricians, and Patent Agents, 9, Westland-row, Dublin. (*Fahie Westlandrow Dublin*)

Fairall, Geo. Wm., Electrician, 34, Ann-st, Tettenhall-rd, Wolverhampton

Fairbairns, W., Glass Globe Merchant, 67, St. Mary-axe, London, E.C.

Fairbank (J. F.) & Son, Civil Engineers, 14, Parliament-st, London, S.W.

Fairburn & Hall, Engineers and Makers of Hall's Injectors, 63, Royal Exchange, Manchester; Palace Works, Wood-st, Stockport; and 99, Fenchurch-st, London, E.C. (*Injector Manchester*)

Faire, S., Ingledene, Stoneygate, Leicester.

Fairfax & Wetter, Patent Agents, 433, Strand, London, W.C.

Fairfield Shipbuilding and Engineering Company, Limited, Engineers, Boiler Makers, and Shipbuilders, Govan; and 113, Cannon-st, London, E.C. (*Fairfield Glasgow*; *Kentigern London*)

Fairweather, C. W., Manager of the Newcastle Branch of the Corlett Electrical Engineering Company, Limited, 13, Mosley-st, Newcastle-on-Tyne. (*Corlett Newcastle-on-Tyne*)

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Fairweather, J. G., B.Sc., Consulting Electrical Engineer, College of Science and Technology, 63, Hanover-st, Edinburgh

Falero, Luis, M.F.S.I.E., Consulting Electrical Engineer, 100, Fellows-rd, South Hampstead, London, N.W.

Falk, Stadelmann & Co, Limited, Insulator Makers, 83 to 87, Farringdon-rd, London, E.C. (*6707*)

Falkenstein, Conrad K., Electrical Engineer, Homeleigh, Lanercost-rd, Tulse Hill Park, London, S.W.

Falkirk Iron Company (R. W. Kennard & Co), Ironfounders and Makers of Arc Lamp Standards, London, Liverpool, Glasgow and Edinburgh. Works: Falkirk, N.B.

Fancourt, John, Scientific Instrument Maker, 55, Mount Pleasant, London, W.C.

Fanshawe and Grant, Electrical Engineers, 181, Queen Victoria-st, E.C., 64, Strand, W.C., and (Works) Willesden, N.W., London

Fanshawe, Harry, Electrician, Thoralby, Fortune Gate, Harlesden, London, N.W.

Faraday Electrical Engineering Company, Limited, Electrical Engineers, Faraday Electrical Works, Campbell-st, Govan, Glasgow; and 3, Trinity-st, Aberdeen (W. M'Whirter, M.I.E.E., Managing Director). (*Faraday Glasgow, 1763; Faraday Aberdeen*)

Faraday & Son, Electric Light Fittings Makers, 3, Berners-st, London, W. (*Faraday London, 3814*)

Fareham Electric Light Company, Limited, Westbury Lodge, West-st, Fareham, Hants.
Capt. John Ramsay ... ... Chairman
Arthur Blake ... ... Secretary
See also page 286.

Farmer (Sir James) & Sons, Limited, Machinists, Mechanical and Electrical Engineers, Adelphi Ironworks, Salford, Manchester

Farmer (Thomas) & Co, Limited, Makers of Acids for Electricians, Billiter-bldgs, 22, Billiter-st, E.C., and Hall's Wharf, Victoria Docks, E., London (*Farmall London, 2247*)

Farmiloe (G.) & Sons, Electrical Bell Fitters, &c., 34, St. John's-st, and Eagle-ct, Clerkenwell, E.C., and Island Lead Mills, Limehouse, E., London. (*George Farmiloe London, 6543*)

Farmiloe, T. & W., Lead Merchants, 19, 21, and 23, Rochester-row, Westminster (*3022*), and 88, Nine Elms-lane, S.W., and Island Lead Mills, Limehouse, E, London (*Farmiloe London, 5010*)

Farquharson, J., Electrician, Woodlands-cottage, High-st, Acton, London, W.

Farrar, William, Electrical Engineer, Rosling & Mathews, Trafalgar Works, Bradford

Farrenden & Son, Electrical Engineers, 57, Graham-rd, Southampton

Farringdon Works, Limited, Engineers, Coppersmiths, &c., Farringdon Works, Shoe-lane, London, E.C.

Farrow, Alfred, Electrical Engineer, Electric Light Station, Goswell-lane, Windsor

Farrow, Henry, Electric Bell Fitter, Chelmsford

Farwig & Johnson, Metal Merchants, 5, Lime-st, and 26, Upper Thames-st, London, E.C. (*11360*)

Faulkner, Bedford & Co, Electrical Apparatus Makers, 16, Endell-st, London, W.C.

Faulkner, J., Electrician and Lightning Conductor Manufacturer, 13, Great Ducie-st, Strangeways, Manchester; and 198, York-rd, Belfast. (*Faulkner Strangeways Manchester*)

***Fawcus, W. P. James, A.M.I.C.E.,** Electrical Engineer, Temple-chmbrs, 29, Brazennose-st, Manchester; and Bowdon, Cheshire. (Managing Director of Manchester Edison-Swan Company, Limited). (*Edison Manchester*)

Fawcus & Cowan, Consulting Electrical and Mechanical Engineers, Bowdon, Cheshire

Fawkes, F. A., Maker of Casings for Electric Wires, Chelmsford

Fazakerley, J., Electrical Engineer, Victoria-st Manchester

Feathers (P. A.) & Son, Dealers in Electrical Apparatus, 43, Dock-st, Dundee

Fedden, Samuel E., Electrical Engineer, Westminster Electric Supply Corporation, Limited, Davies-st, Mayfair, London, W.

Federated Institution of Mining Engineers, Newcastle-upon-Tyne. (*Monco Newcastle-upon-Tyne, P.O. 436, Nat. 1157*)
A. Sopwith... ... ... President
M. Walton Brown ... ... Secretary

Feeny, V. I., Consulting Engineer and Patent Agent, 60, Queen Victoria-street, London, E.C. (*Victor Feeny London*)

Feetham (Mark) & Co, Electric Bell Makers, 9, Clifford-st, and 17, Soho-sq, London, W.

Fell, A. L. C., Electrician, 2, Staple Inn, London, W.C.

Fell (R. H.) & Son, Limited, Electric Light Contractors, Windermere. (*Fells Limited Windermere*)

Fell & James, Consulting Engineers, 1, Queen Victoria-st, London, E.C. (*Lodestone London*)

Fell (John) & Co., Brassfounders, St. James' Brass Foundry, Wolverhampton; and 13, West Bank, Stamford Hill, London, N.

Fell & Wilding, Patent Agents, 1, Queen Victoria-st, London, E.C. (*Lodestone London*)

Fellows (H.) & Son, Electric Launch Builders, Great Yarmouth. (*Fellows Great Yarmouth*)

Fellows, Thomas H., Electrical Engineer, 88, Corporation-st, Walsall

Felt (W. O.) & Co, Makers of Felt's Automatic Lubricator and Lubricating Compound, 9 and 10, Southampton-st, High Holborn, London, W.C.

FELTEN & GUILLEAUME, Electrical Wire Manufacturers (W. F. Dennis & Co, Agents, 11, Billiter-st, London, E.C.) (*Fredennis London, 4350*) **See Advt., p. 9.** (*See also* CONTINENTAL DIVISION)

Fenlon & Sons, Electric Bell Fitters, 8, Tudor-st, London, E.C.

Fenn & Co, Limited, Manufacturers of Tools, Stores, and Fittings for Electricians, 10, Railway-approach, London Bridge, S.E. (R. Hollis, Secretary)

Fenn, W. T., Electric Bell Fitter, 5, North-st, Sloane-st; A1, Markham-st, Chelsea; and 2, College-pl, Kinnerton-st, London, S.W.

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Fenner (J. H.) & Co, Belting Manufacturers, Devonshire-chmbrs, Bishopsgate-st, London, E.C.; and Hull

Fenton Bros, Dynamo Belting Manufacturers, Lanark

Fergus, P. R., Electrician (Messrs. Harvies & Co., Limited), 222, Broomielaw, Glasgow

Ferguson (J.) & Co, Electrical Engineers, Ballymena, Co. Antrim, Ireland

Ferguson, C. J., Electrician, 106, Bunhill-row, London, E.C.

Ferguson, Henry, Telegraph Engineer, Secretary's Office (Intelligence Section), G.P.O., St. Martin's-le-Grand, London, E.C.

Ferguson, Russell Forrester, Electrician, 1 and 2, Great Winchester-st, London, E.C.

Ferguson, Thomas, Electric Bell Fitter, 128, Cambridge-st, Glasgow

Fergusson, D., Electrician, 190, Eglington-rd, Woolwich, Kent

FERRANTI, S. Z. DE, Limited, Electricians and Engineers, Charterhouse-sq, and St. Benetchmbrs, Fenchurch-st, London, E.C. (*Ferranti London*) **See Advt., p. 594.**

See also page 286

Ferranti, Sebastian Ziani de, Electrical Engineer, 27, Charterhouse-sq, and St. Benetchmbrs, Fenchurch-st, London, E.C. (*Ferranti London*)

Festing, Major-Gen. E. R., R.E., F.R.S., Electrician, The Residences, South Kensington Museum, London, S.W.

Fewster, T. W., Electrical Engineer, 10, Lorne-gardens, Regent's Park, London, N.W.

Finch, B. T., Director-in-Chief, Indo-European Government Telegraph Department, India Office, Whitehall, London, S.W.

Fidler, T. Claxton M.I.C.E., Professor of Engineering, University College, Dundee, N.B.

Field, Algernon Sidney, Electrician, Aberdeen Lodge, Worple-rd, Wimbledon

Field, Edward, Consulting Engineer, Field's "M.P." Development Association, Limited, 13 and 14, Abchurch-lane, London, E.C.

Field, H., Electrician, 12, London-st, London, E.C.

Field, J. C. & J., Limited, Insulating Material Manufacturers, 15, Upper Marsh, Lambeth, and 3, Bermondsey New-rd, London, S.E. (*Ozokerit London, 4756*)

Field, Jas. J., Telegraph Ink Manufacturer, 25, Helmet-row, Old-st, London, E.C.

Field, J. Hermann, Electrical Engineer, Claremont, Woodberry Down, London, N.

Field & Son, Manufacturing Electricians, Market-sq, Aylesbury

Field, Michael Birt, Electrical Engineer, Claremont, Woodberry Down, London, N.

Field's "M.P." Development Association, Ltd., Motive Power Development Engineers, 13 and 14, Abchurch-lane, London, E.C. (*Combinable London 11307*)

Fielder, W., Maker of the Fielder Patent Electric Clock Alarm, 57, Shakespeare-rd, Herne Hill, London, S.E.

Fielding & Platt, Makers of the Fielding Gas Engine, Atlas Works, Gloucester

Fiford (E. T.) & Sons, Manufacturing Electricians, 63, Northam-rd, Southampton; and at Bournemouth

Fincham, J., Electrical Engineer, Central Station, Dublin-st, Carlow

Finlay (John) & Co, Lightning Conductor Fitters and Manufacturers of Electric Light Fittings, 18, Renfield-st, and Overnewtown Works, Glasgow (*1455*)

Finlay, W., Electrical Engineer, Manager of the Electrical Department, Messrs. Smiths & Co., Limited, 89, George-st, Edinburgh

Finnis, T., Secretary Direct United States Cable Company, 240, Winchester House, Old Broad-st, London, E.C.

Fippard, A. J., Electrical Engineer, Bournemouth

FIRE OFFICE AND ALL OTHER ELECTRIC LIGHTING RULES—*see pp. 133 to 157*

Fireless Motor Syndicate, Limited, Mechanical Engineers, 18, Booth-st, Manchester (*1054*)

Firth (Thos.) & Sons, Limited, Engineers, Manufacturers of Engineers' Tools, &c., Norfolk Works, Sheffield; and 110, Cannon-st, London, E.C. (*Firth Sheffield; Ezra London*)

Fischer, H. C., Telegraph Controller, Central Telegraph Office, General Post Office, London, E.C.

Fisher, H. O., Telegraph Engineer, Taff Vale Railway Company, Cardiff. (*Oakden Cardiff*)

Fisher, W. Clark, Electrician, 3, Horbury-crescent, Notting Hill Gate, London, W.

Fislen & Co, Electrical Engineers, St. Mirren Works, Macdowall-st, Paisley, N.B. (*Fislen Engineers Paisley*)

Fitch, Charles J., Electrician, The Braes, 2, Ouseley-road, Wandsworth Common, London, S.W.

Fitt Bros. & Davies, India Rubber and Asbestos Merchants, 17, Wind-st, Swansea. (*Fitt Swansea, 14 and 14a*)

*FitzGerald, Desmond G., Consulting Electrician and Electro-Chemist, 94, Loughborough-rd, and 75, Akerman-rd, Brixton, London, S.W.

*Fitzgerald, George Francis, M.A., F.R.S., Professor of Natural and Experimental Philosophy, Trinity College, Dublin

Flannery, Baggallay & Johnson, Consulting Engineers, 9, Fenchurch-st, and at Lloyd's, London, E.C. (*11338*)

Fleetwood, Chas. Henry, A.I.E.E., Electrician, 10, Edwardes-sq, Kensington, London, W.

Fleetwood, Charles Thomas, Assistant Superintending Engineer, London and District Postal Telegraphs, Mount Pleasant, E.C., and 48, Greenwood-road, Dalston, N.E., London

Fleming (A. B.) & Co, Oil Refiners, Caroline-park, Edinburgh (*801*); and 15, Whitefriars-st, Fleet-st (*2743*), and 101, Leadenhall-st (*4052*), London, E.C. (*Caroline Edinburgh; Fleming London*)

Fleming, Algernon, Electric Bell Fitter, &c, The Cross, Ringwood, Hants

FLEMING, BIRKBY & GOODALL, Limited, Driving Band and Wire Staple Makers, West Grove Mills, Halifax. (*Fleming Halifax*) **See Advts., pp. 466 and 616**

Fleming & Ferguson, High-Speed Steam Engine Makers, Paisley, N.B. (*Phœnix Paisley*)

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Fleming (Hugh) & Co, Manufacturing Electricians, 1, Teviot-pl, and 3, Rose-st, Edinburgh

*Fleming, Prof. J. A., M.A., D.Sc., F.R.S., M.I.E.E., Consulting Electrician and Electrical Engineer, 100, Victoria-st, S.W., and University College, Gower-st, and 9, Clifton-gardens, Maida Hill, N.W., London

Fleming, William, Telegraph and Electric Light Engineer, Furness Railway, Barrow-in-Furness

Fletcher, B. M., Electrician, 7, Victoria-st, London, S.W.

Fletcher, G., Consulting Electrical Engineer, 59, Wilson-st, Derby

Fletcher, G. E., Electrician, The Homestead, Cale Green, Stockport

Fletcher, James, Electrical Engineer, 17A, St. James-st, Burnley. (*Fletcher Electrician Burnley*)

Fletcher, J. W., Chief Telegraph Superintendent and Engineer, London and North-Western Railway Company, London-road Station, Manchester. (*Fletcher North-Western Manchester, 385*)

Fletcher, Russell & Co, Limited, Engineers, Tool Makers, and Metal Workers, Thynne-st, Warrington; Pendleton, near Manchester; and at London. (Thomas Fletcher, Managing Director). (*Gaseries Warrington, 70; Gaseries London*)

Fletcher, R. H., B.A., Electrician, St. Mary's-chambers, Cardiff

Fletcher, Thomas, F.C.S., Electrician, Warrington

Fletcher, Thomas, Telephone Engineer, National Telephone Company, Oxford-court, Cannon-st, E.C., and 188, Broadhurst-gardens, West Hampstead, N.W., London (*9090*)

Flinders, M. T., Dealer in Electrical Apparatus, 145, Upper-st, Islington, London, N.

Flockton, Tompkin & Co, Steel Manufacturers, Converters, &c., Newhall Steel Works, Sheffield. (*Tompkin Sheffield*)

Flood-Page, Major S.—*see* Page, Major S. Flood

Flood, W. H., Electrician, c/o Marine Engineer's Institute, Sunderland

Flower, J. W., jun., Electrician, 59, Hartham-rd, Camden-rd, London, N.

Floyd, E. M., Makers of Electric Alarms, 32, Prothero-rd, Fulham, London, S.W.

Floyd (Thomas) & Co, Civil and Electrical Engineers, 28, Victoria-st, London, S.W (*Dyolf London, 3085*)

Flügell, J. P., Assistant Electrician, Great Northern Telegraph Company, Newcastle-upon-Tyne

Folkard, William C., Electrical Agent, Borough Hall, Stockton-on-Tees

Fontainemoreau (L. de) & Co, Patent Agents, 4, South-st, Finsbury, London, E.C.

Foote, Henry, Electrical Engineer, 68, Victoria-st, London, S.W. (*Slatter London, 3138*)

Foote & Von Buch, Electrical Engineers, 11, Queen Victoria-st, London, E.C. (*Technique London, 1928*)

Forbes (D. W.) & Co, Limited, Electrical Engineers, Manufacturers of Electrical Apparatus, Machinery, &c., Smithfield Engineering Works, New-rd, Blackwall, London, E.

Forbes, Sir Chas., Consulting Engineer, 28, Queen's Gate-ter, South Kensington, London, S.W.

*Forbes, Prof. George, M.A., F.R.S., M.Inst.C.E., &c., Consulting and Electrical Engineer, 34, Great George-st, London, S.W.; and 35, Wall-st, New York

Forbes, J. Gilbert, British and Foreign Manufacturers' Agency, 12, York-st, Glasgow. (*Shuttle Glasgow, 3953*)

Forbes, J. Staats, Chairman of the Edison and Swan United Electric Light Company, Limited, and of the Swan United Electric Light Company, Limited, and President of the National Telephone Company, Limited, Garden Corner-house, Chelsea Embankment, London, S.W. (*3170*)

Ford, A. C., Electrical Engineer, c/o Thames Ironworks and Shipbuilding Company, Limited, Orchard-yard, Blackwall, London, E.

Ford, Frederic W., Electrician, St. Keverne, 4, Upper Kyverdale-rd, Stamford Hill, London, N.

Ford (John) & Co, Makers of Glass Globes and Shades, Holyrood Glass Works, Edinburgh. (London and Export Agent: G. G. MacWilliam, 20, Bartlett's-buildings, London, E.C.)

Ford-Lloyd Manufacturing Company, Limited, Manufacturers of Dry Batteries, 2-4, Phœnix-pl, Mount-pleasant, London, W.C.

Ford-Lloyd, Arthur, Electrical Engineer, 28, Phœnix-pl, Mount Pleasant, W.C., and 5, Hunter-st, W., London

Ford-Moore, A. P., Civil and Electrical Engineer, Stanley House, Windsor

Forde, H. C., M.I.C.E., Engineer and Electrician, 4, Great Winchester-st, London, E.C.

Foreign and Colonial Arc Accumulator Company, Limited, Manufacturers of Batteries and Electrical Apparatus, 99, Cheapside, London, E.C.

See also page 286.

Foreign Patents Realization Company, Limited, Patent Brokers, 52, Southwark-st, London, S.E. (W. V. Barwell, Secretary)

Foreign Pilsen Electric Light and Power Company, Limited, 11, Abchurch-lane, London, E.C. (Charles Akers, Secretary) (*Akers c/o Enshrine London*)

See also page 286.

Forndran (H.) & Sons, Ivory and Wood Turners, 3, Marshall-st, Golden-sq, London, W.

Forrest (G.) & Son, Limited, Electrical Engineers, 2, Great New-st, and 5 and 6, Nevill's-court, Fetter-lane, London, E.C.

Forshaw, Alfred C., Telegraph Engineer, Direct United States Cable Company, 39, Mark-lane, London, E.C.

Forster and Gregory, Limited, Manufacturing Chemists, Lonesome Chemical Works, Streatham Common, London, S.W. (*Redantim London*)

Forster, R., Electrician, J. Sunderland & Co, Victoria Electrical Works, Halifax

Fossick & Company, Limited, Steel and Iron Merchants, 86, Cannon-st, London, E.C.

Foster, A. Le Neve, Telegraph Engineer, 61, Cadogan-sq, London, S.W.

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Foster, Prof. G. Carey, F.R.S., M.I.E.E., Consulting Electrician, University College, London, and 18, Dalehamgdns, South Hampstead, N.W.

Foster, H. Llewellyn T., A.M.I.C.E., A.I.E.E., Resident Engineer, Westminster Electric Supply Corporation's Central Station, Davies-st, Mayfair, London, W.

Foster, H. T., Consulting Electrical Engineer, 28, Victoria-st, London, S.W.

Foster, J., Resident Engineer, Nelson Corporation Central Electric Light Station, Engineer's Office, Gas Works, Nelson

Foster & Williams, India Rubber and Gutta Percha Manufacturers, 87, Grange-rd, Bermondsey, London, S.E.

Foster (W.) & Co, Limited, Engineers, Wellington Foundry, Lincoln. (*Foster Lincoln*)

Foulger, Charles, Maker of Electric Indicators for Ships, &c., 57 and 58, Wapping, and Sparling-st, Liverpool

Foulis, William, Engineer and Manager, Corporation Electric Light Station, John-st, Glasgow

Fournier, E. E., Electrician, Royal College of Science, Dublin

Fowkes, —, Electrical Engineer, Bowness

Fowler Insulator Syndicate, Limited—*in liquidation*, (R. B. Fastnege, 5, Lime st, London, E.C., Liquidator)

Fowler (John) & Co, Leeds, Limited, Engineers, 6, Lombard-st, London, E.C., and Steam Plough Works, Leeds. (*Steamplow London; Fowler Leeds*)

See also page 286.

Fowler, Sir John, Bart., K.C.M.G., LL.D., Consulting Engineer, Thornwood Lodge, Campden Hill, Kensington (*8504*), and 2, Queen-square-pl, London, S.W. (*3043*)

Fowler, Lancaster & Co, Limited, Manufacturers of Electrical Supplies, Birmingham

Fowler (Percival) & Co., Consulting Engineers, 16, St. Helen's-pl, London, E.C. (*Ingenieur London*)

FOWLER-WARING CABLES COMPANY, Limited, Manufacturers of Telegraph, Telephone, Electric Light, Power, and Submarine Conductors, General Offices, 4, Victoria-mansions, 32, Victoria-st, London, S.W. (*Underground London, 3180*) Works: North Woolwich (*Fowler-Waring North Woolwich, 5091*). **See Advts., pp. 302 and 475**

W. Fowler ... ... Chairman
A. E. Mavor ... ... General Manager
D. Stephen ... ... Secretary.

See also page 286.

Fowler, J., Electrician, 9, Heathville-rd, Gloucester

Fowler's Engineering Company (Limited), Mechanical and Electrical Engineers, 98, Tooley-st, London, S.E.

Fowler, Wm., Telegraph Inspector, Postal Telegraphs, Aberdeen

Fowles (G.) & Sons, Limited, Engineers and Ironfounders, 40-47, Green-st, Birmingham

Fox, Charles James, Engineer and Contractor, and Manufacturers' Agent, 54, New Broad-st, London, E.C.: and 61, Lord-st, Liverpool

Fox, Sir Douglas and Francis, Consulting Engineers, 28, Victoria-st, London, S.W. (*Traction London, 5040*)

Fox, F. W., Electrical Engineer, 39, Bank-st, Ashford, Kent

Fox (S.) & Co, Limited, Telegraph and Telephone Wire Manufacturers, Stocksbridge Works, near Sheffield; and 18, St. Swithin's-lane, London, E.C. (*Fox Deepcar*)

Foxcroft, J. F., Telegraph Instrument Case Maker, 39, Lever-st, St. Luke's, London, E.C.

Foxcroft, W. M., Telegraph and Telephone Case Maker (Wholesale and Retail), 36, Percival-st, Clerkenwell, London, E.C.

Contractor to the Postal Telegraphs and to the principal Railway Companies of Great Britain and the Continent

Foyster, A. H., Electrical Engineer, 93, Amity-grove, Cottenham Park, Wimbledon

Frain & Son, Representatives of the Edison and Swan United Electric Light Company, Castle-st, Dundee

France & Morgan, Ships' Telegraph Makers, Whitefield Brass Works, Carmichael-st, Govan, Glasgow. (*France Glasgow*)

Francis, Arthur H. M., Electrical Engineer, c/o Edison & Swan United Electric Light Co, Ltd, 110, Cannon-st, London, E.C.

Francis, F. H., Electrician, 8A, St. Aldate's, Oxford

Francis, F. R., Telegraph Engineer, 1, Batoumgdns, Kensington, London, W.

Francis (R.) & Sons, Electric Light Engineers and Manufacturers of Electrical Apparatus, Market-pl, St. Austell, Cornwall

Francis, Thomas E., Manufacturer and Importer of Optical, Electrical, and Mechanical Mechanism, 64, Colston-st, Bristol

Frank (G.) & Co, Limited, Engineers, Electricians and Whitesmiths, 25, Blandford-st, and 15, Dorset-mews, East Manchester-sq., London, W.

Frank, T., Zinc Merchant, 8, Bush-lane, London, E.C. (*Zercha London*)

Frankenburg, Max, India Rubber Manufacturer, Sherbourne-st, Strangeways, Manchester; and 59, Knightrider-st, London, E.C. (*Sincolor Manchester, 692b.*)

Franks, A., Electrician, 2, King-st, 95, Deansgate, and 44, Market-st., Manchester (*4744*); and Whitefriargate, Hull

Franks, F., Dealer in Electrical Supplies, Low Bridge, Keighley

Fraser, A., Electrician, Eastern Telegraph Company, Ltd, 11, Old Broad-st, London, E.C.

Fraser & Chalmers, Limited, Agents for the Pelton Water Wheel, 45, Threadneedle-st, London, E.C.; and Erith, Kent. (*Vanner London, 11168*)

Fraser & Fraser, Boiler Makers, Monument-chmbrs, King William-st, London, E.C. Works: Bromley-by-Bow, London, E. (*Pressure London, 5420*)

Fraser, James, Telegraph Engineer, Postal Telegraphs, Aberdeen

Fraser, James, M.Inst.C.E., Consulting Engineer, Inverness

Fraser (John) & Sons, Consulting Engineers, 14, Victoria-st, London, S.W.

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Fraser (W. J.) & Co, Electrical and Mechanical Engineers, 98, Commercial-rd East, London, E. (*Fraser Engineer London, 4413*)

Frazer's (Charles) Executors, Makers of Casings for Electric Light Wires, City Saw Mills and Steam Joinery Works, Norwich.

Frazer, T., A.M.I.C.E., Electrical Engineer, 114, Broadway, Plaistow, Essex

Frecheville, R. J. & W., Consulting Engineers, 33, Broad-st-avenue, London, E.C. (*Fratribus London, 2476*)

Frederison M., Electrician, 8, Regent-st, London, W.

Freedman, C. H., Electrical Engineer, 1, Vernon-chambers, Southampton-row, London, E.C.

Freeman, John George, Electrical Engineer, London Electric Supply Corporation's Station, Blackfriars-rd, London, S.E.

Freeman (Thomas) & Co., Electric Light Engineers and Contractors, 21, Swallow-st, Piccadilly, London, W.

Freeman, W., Manufacturer of Electrical Apparatus, 84, Geneva-rd, Brixton, London, S.W.

Freeman, W. S., Maker of Freeman's Patent Electric Friction Hoists and Gear, Invicta Works, Otford, Kent. (*Freeman Otford Kent*)

French, Archibald John, Electrician, 64, Anthony-st, Commercial-rd, London, E.C.

Freund, Edwin, Mechanical and Electrical Engineer, c/o Messrs. Th. Raaschou & Co, 63, Queen Victoria-st, E.C.; and 122, Trinity-rd, Upper Tooting, S.W., London.

Fricker, Guy C., Electrical Engineer, 46, Queen Victoria-st, E.C., and 14, Spencer-rd, Putney, S.W., London

Fridlander, A. E., Maker of Non-Magnetic Watches, Coventry

Froggatt, Thomas, jun., Electrician, 55, Thomas st, Kennington, London, S.E.

Froggatt's Electric Lighting Company, Limited, Electric Light Engineers (Owners of Froggatt's Patents), 3 and 4, Great Winchester-st, London, E.C.

Frost, H. G., Electric Bell Fitter and Dealer in Electric Supplies, 187, High-st, Deal, and at Walmer. (*Frost Deal*)

Fry, C. C., Electrical and Mechanical Engineer, 12, South-villas, Camden-sq, London, N.W.

Fryer, W. J., Electrical Engineer, Messrs. Graham and Biddle, 463, Oxford-st, W., and Danecroft, Silverdale, Sydenham, S.E., London. (*3596*)

Fuerst Brothers, Antimony Refiners and Chemical Merchants, 17, Philpot-lane, London, E.C. (*Fuerst London, 1050*)

Fulham Pottery and Cheavin Filter Company, Battery Jar, Porous Cell, and Insulator Makers, Fulham Pottery, Fulham, London, S.W. (*Stoneware London*)

Fuller, George, Electrical Engineer, Newcastle Wharf Works, 547, Old Ford-rd, Bow, London, E.

Fuller, Horsey, Sons & Cassell, Electrical and Mechanical Valuers, 11, Billiter-sq, London, E.C. (*Fuller Horsey London*)

Fuller (J. C.) & Son, Electricians and Telegraph Engineers, 547, Old Ford-rd, Bow, London, E. (*5421*)

Fuller, John Leslie, Electrical Engineer, 20, Bucklersbury, E.C., and 3, Hardy-rd, Westcombe Park, S.E., London

Fuller & Tate, Electrical and Mechanical Engineers and Contractors, 20, Bucklersbury, London, E.C.

*Fuller, Thomas, F.R.G.S., Managing Director of the Brazilian Submarine Telegraph Company, Limited, and of the African Direct Telegraph Company, Limited, Winchester House, Old Broad-st, London, E.C. (*Amulet London*)

Fulton, T. Crichton, A.I.E.E., Consulting Electrical Engineer, 74, Buchanan-st, Glasgow

Furse, W. J., Electrical Engineer, 17, Burton-st, Nottingham (*Furse Nottingham*)

Furze, J., Superintendent Commercial Cable Company, Liverpool

Fyers, Evan W. H., A.I.E.E., Electrical Engineer, Electrical Installation Company, Limited, 64 and 66, Victoria-st, London, S.W.

Fyfe, A. L., Electrical Engineer, Fyfe-Main Electric Lighting and Construction Company, Electric-avenue, Brixton, London, S.W.

Fyfe, J., Electrician, 25, Garlick-hill, London, E.C.

Fyfe-Main Electric Lighting and Construction Company, Electric Light Engineers and Contractors, Electric-avenue, Brixton, London, S.W. (A. L. Fyfe, Electrical Engineer)

Fylde Rubber Company, Limited, India Rubber Manufacturers, 59, Gresham-st, London, E.C.

Fynn, Samuel, Electric Light Engineer and Contractor, 670, Commercial-rd, London, E.

— G —

Gabriel (Thos.) & Son, Creosote Manufacturers, Commercial-rd, Lambeth (*4718*), and 341, Rotherhithe-st, London, S.E.

Gadd, Thomas, Engineer and Manufacturer of Bolts, Nuts, &c., Ross Rivet Works, Rowley Regis, near Dudley; and Salford. (*Gadd Rowley Regis*)

Gaine, Wm. E. L., General Manager of the National Telephone Company, Oxford-court, Cannon-st, E.C., and 100, St. George's-sq, S.W., London. (*3032*)

Galbraith & Church, Consulting Engineers, 20, Victoria-st, London, S.W.

Gale, Joseph, Electric Light Engineer, 102, Fetter-lane, London, E.C.

Galgey, J. M., Electrician, 2, Clifton-terrace, Cork

Gallenkamp (Adolph) & Co, Chemical Glass and Apparatus Manufacturers, 2, 4 and 6, Cross-st, Finsbury, London, E.C.

Gallimore (W.) & Sons, Nickel Silver, Copper, and Brass Wire and Copper Tape Manufacturers, Arundel-st, Sheffield. (*Gallimore Sheffield, 1063*)

Galloway, M. P., Maker of Electric Light Fittings, Lubricants, &c., 24, Shore, Leith (*Galloway Leith, 495*)

Galloways, Limited, Boiler Makers, Knott Mill Iron Works and Branch Iron Works, Ardwick, Manchester; and 64, Cannon-st, London, E.C. (*Galloway Manchester, 195*)

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Galpin, W., Electrical Engineer, 111, Church-rd, Fratton, Portsmouth

Galton, Captain Sir Douglas, K.C.B., D.C.L., F.R.S., LL.D., F.L.S., F.G.S., F.R.G.S., M.I.E.E., General Secretary of the British Association, 12, Chester-st, Grosvenor-pl, London, S.W. (*Gaudet London*)

Galway Electric Company, Electric Light Engineers, Newtownsmyth, Galway, Ireland. (*Electric Company Galway*)
James Perry ... . Man. Director
J. E. Pearce ... ... Engineer

Gameson (T.) & Sons, Manufacturers of Electricians' Castings, Britannia Foundry, Rushall-st, Walsall

Gammon (W.) & Co, Makers of Glass Globes for Arc Lamps, Belmont Glass Works, Great Brook-st, Birmingham; and 30, Holborn, London, E.C. (*Gammon Birmingham*)

Gandy Belt Manufacturing Company, Limited, Wheatland Works, Seacombe, Cheshire; and at 120, Queen Victoria-st, London, E.C.; Manchester, Glasgow, Bradford, and Courbevoie (France).

Gannon, W. E., Mechanical Engineer and Machinist, 17 and 18, Springfield-hill, Chelmsford

Garbutt, Alfred E., Electrician and Representative in the North of England of the Fowler-Waring Cables Company, Limited, 56, Holly-avenue, Newcastle-on-Tyne

*Garcke, Emile, Managing Director of the Electric Construction Company, Limited, and of the Electric and General Investment Company, Limited, Queen-street-chmbrs, Queen-st, London, E.C. (*Concordance London, 1887*)

Garden & Co, Dynamo Oil Manufacturers, 88, Leadenhall-st, London, E.C. (*Ariston London, 5056*)

Gardner, Colin M., Electrical Engineer (Messrs. Browning and Gardner), 122, George st, Edinburgh

Gardner & Co., Electrical and Scientific Instrument Maker, 53, St. Vincent-st, Glasgow

Gardner, H., Patent Agent, 166, Fleet-st, London, E.C.

GARDNER (L.) & SONS, Electrical and Mechanical Engineers, Hadfield-st, Cornbrook, Manchester. **See Advt., p. 48**

Gardner (R.) & Co, Makers of Electric Light Fittings, 66, Granville-st, Birmingham

Gardner, Starkie & Co, Metal Workers, 29 Albert Embankment, London, S.E.

Garford, J., Electrician, 3, Vernon-chmbrs, Southampton-row, London, W.C.

Garfitt, —, Electrician, 10A, Firth-st, Oldham, Lancs.

*Garnett, Prof. W., Consulting Electrician and Electrical Engineer, and Technical Adviser to the Technical Education Committee of the London County Council, Spring-gdns, London, S.W.

Garnham & Co, Electricians and Telegraph Engineers, Sash-ct, Wilson-st, Finsbury, London, E.C.

Garnier Enamelled Letter and Advertising Sign Company, Limited, Enamellers, Metal Workers, &c., 61, Farringdon-rd, London, E.C.

Garnock, Bibby & Co, Limited, Manufacturers of Hemp and Wire Ropes, Cotton Canvas Belting, &c., 36, Chapel-street, Liverpool; and 14, King-st, West India Dock-road, London, E. (*Garnock Liverpool; Garnock London, 1474*)

Garrard, C., Electrical Engineer, 20, Oseneycres, Camden Town, London, N.W.

Garrard (R.) & Co, Timber, Mahogany and Hardwood Merchants, 206, Bethnal Green-rd, London, E. (*Acajou London 1020*)

Garrard, Walter C., Electrician and Electrical Engineer, 10, Hearne-rd, Chiswick, London, W.

Garratt, H. A., Electrician and Lecturer on Engineering, University College, Bristol

Garratt, J. H., A.I.E.E., Engineer and Electrician, Acton Hill Electrical Works, Acton Hill, London, W.

Garrett, F. T. & A., Manufacturing Electricians, High st, Dunstable; and High-st, Towcester, (District Agents of the Consolidated Telephone Construction and Maintenance Co., Limited). (*Garrett Dunstable*)

Garrett (J. Dunnell) & Co, Limited, Mechanical and Electrical Engineers, Tool Makers, &c., Festiniog Foundry, Merionethshire

Garrett (R.) & Sons, Engineers and Boiler Makers, Leiston Works, Suffolk. (*Garrett Leiston*)

Garvey, G. B., Electrical Engineer, 23, South Frederick-st, Dublin

Gas Engineers' Magazine (monthly), 139, Moor-st, Birmingham. (Ann. sub., 6s. 6d.) (*468*)

Gas Power Syndicate, Limited, Makers of the Gaze Gas Engine, 37, Lincoln's Inn-fields, London, W.C.

Gas Purification and Chemical Company, Limited, 160-162, Palmerston-buildings, London, E.C. (*Purification London*)

Gas World (weekly), 3, Ludgate-circus-bldgs, London, E.C. (Price 3d.) (*Allangas London*)

Gaseous and Liquid Fuel Supply Company, Limited, Makers of Gas Producers for Gas Engines, 25, Market-st, Manchester

Gaskell & Grocott, Makers of Switch Bases and Coverings, White Hall Works, Longport, Stoke-on-Trent. (*Insulator Longport*)

Gatehouse, J. W., City Electric Light Inspector, 36, Broad-st, Bath

Gatehouse, T. E., Electrical Engineer, 60, Gresham-rd, Brixton, London, S.W.

Gates Ironworks Company, Makers of Electric Mining Plant, 73a, Queen Victoria-st, London, E.C.

Gates (R. H.) & Son, Mica Merchants, Victoria Mills, Fairclough-st, London, E.

Gaudin (R.) & Co, Electrical Apparatus Manufacturers, 8, Infirmary-st, Wellington Bridge, Leeds

Gauntlett, W. H., Manufacturer of Pyrometers, Middlesbrough (*Pyrometer Middlesbrough*)

Gatward (John) & Son, Electric Light and General Engineers, Swan Iron Works, Hitchin; and at Stevenage. (*Gatward Hitchin*)

Gatward, T. W., Electrical Engineer, Swan Iron Works, Hitchin

*Gavey, J., Principal Technical Officer, General Post Office, London, E.C.; and Hollydale, Hampton Wick.

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Gawthorp, C. A., A.I.E.E., Electrical Inspector, 38, Clyde-rd, Croydon

Gawthorp, T. J., Art Metal Worker to H.R.H. the Prince of Wales, 16, Long-acre, London, W.C.

Gay, Albert, Electrical Engineer to the Islington Vestry, Vestry Hall, Upper-st, Islington, London (*7649*)

Gedge & Feeny, Patent Agents, 60, Queen Victoria-st, London, E.C.

Gee, Basil, Electrical Engineer, 148, Brompton-road, London, S.W.

*Gee, W. W. Haldane, B.Sc., F.C.S., Consulting Electrician, Senior Demonstrator and Assistant Lecturer in Physics, Owens College, and in the Victoria University; and 124, Raby-st, Moss-lane E., Manchester

Geen, Charles, Electrical Engineer, Okehampton, Devon.

Geen, Henry, Electrical Engineer, Okehampton, Devon.

*Geipel, William, M.I.E.E., Superintending Engineer, Brush Electrical Engineering Company, 112, Belvedere-rd, Lambeth, London, S.E. (*4564*)

Gendall, W. H. S., Manager and Engineer of the Corporation Gas Department, Bury, Lancs.

GENERAL ELECTRIC COMPANY, Limited, Manufacturers of Electric Light Fittings, Telephones, Electric Bells, &c. (Agents for the Crocker-Wheeler Motors), 69 and 71, Queen Victoria-st, London, E.C.; 196, St. Vincent-st, Glasgow; and 39, Corporation-st, Birmingham. Works: 45, Chapel-st, Salford, Manchester. Lamp Factory, Brook Green Works, Hammersmith. (*Electricity London, 1887; Induction Manchester, 652; Apparatus Glasgow*). **See Advt., p. 486**

G. Binswanger (Managing Director)
Max Binswanger ... ...
H. Hirst ... ... } Directors

See also page 286

General Electric Power and Traction Company, Limited—*now* The Acme and Immisch Co (*q.v.*)

General Electrolytic Parent Company, Limited, Electro-Metallurgists, Star-chmbrs, Moorgate-st, London, E.C. (Andrew W. Barr, Secretary)

General Engine and Boiler Company, Steam Engine Makers, Hatcham Iron Works, Pomeroy-st, New Cross-rd, London, S.E. (*Oxygen London*)

General Hydraulic Power Company, Limited, Hydraulic Engineers, Palace-chmbrs, 9, Bridge-st, Westminster, London, S.W.

General Inventions Syndicate, Limited, Patent Business Agents, 5, Great James-st, Bedford-row, London, W.C. (H. T. Norton, Secretary)

GENT & CO, Wholesale Manufacturing Electricians, Faraday Works, Leicester; 3, Maiden-lane, Queen-st London, E.C.; 47, High Bridge, Newcastle-upon-Tyne; 27, Oswald-st, Glasgow; and at Cardiff; and Belfast. (*Gents Electricians Leicester, 151*)

Gent, Frank E., Surveying Instrument Maker, 96, Rosoman-st, Clerkenwell, London, E.C.

*Gent J. T., Electrician, Faraday Works, Braunstone-gate, Leicester

*Gerhardi, Charles A., M.I.E.E., Manager Direct Spanish Telegraph Company, 280, Winchester House, Old Broad-st, London, E.C.

Gerhardt, Charles Frederick, Mica Merchant, 34, Seething-lane, London, E.C.

Gething, E. A., Electric Bell Fitter, &c., 42 and 19, Primrose-hill, Salisbury-sq, Fleet-st, London, E.C.

Giant's Causeway, Portrush and Bush Valley Railway and Tramway Company, Limited Portrush, Antrim. (D. Fall, jun., Secretary.)

See also pages 159 and 286.

Gibb (James) & Co, Engineers and Iron Merchants, 99, Fenchurch-st, London, E.C. (*Tamergram London 4154*)

Gibbings, A. H., Electrician and Electrical Engineer to the Hull Corporation, Electric Light Station, Hull.

Gibbings, W., M.I.E.E., Electrical Engineer, Mersey View, Widnes, Lancs.

Gibbins (Richard C.) & Co, Engineers and Makers of Cranes, Lifts, &c., Berkeley-st, Birmingham. (*Gibbins Birmingham*)

Gibbons, Henry, Public Lecturer on Electricity and Magnetism, Charmouth, R.S.O., Dorset

Gibbons, James, Electrician, Haseley Iron Works, Haseley, Tetsworth, Oxfordshire. (*Gibbons Great Milton*)

Gibbons, W. C., Electrical Engineer, Cadney, Brigg, Lancs.

Gibbs, John Dixon, Electrician, Conservative Club, St. James's-st, London, S.W.

Gibbs (Renton) & Co, Ltd, Ventilating Engineers, 259-261, Mill-st, Liverpool

Gibson, J., Superintending Engineer, Postal Telegraphs, 38, York-pl, Edinburgh

Gibson, Joseph R., Electrical Engineer, 312, Kennington Park-rd, London, S.E.

Gibson, Osmund, Mechanical Engineer, 60, Queen Victoria-st, London, E.C.

Giddings & Dacre, Manufacturers of Electric Light Fittings, Ducie-st, London-rd, Manchester. (*Junction Manchester, 191 Nat., and 918 New*)

Gideon, Edgar T., Electrical Engineer, 38, Gordon-rd, Ealing, London, W.

Gilbert, Arthur E., Electrical Engineer, Malvern House, Whitby, Northumberland

GILBERT (C. E. G.) & CO, Electrical Engineers, Manufacturers and Contractors, 35, High-st, Kensington, and 16, Hanway-st, Oxford-st, London, W.

Gilbert, John J., Electrician, 72, Cambridge-st, The Crescent, Birmingham

Gilbert, Walter K., Leather Belting and Manganese Merchant, 6, Dowgate-hill, London E.C. (*Gilbertia London*)

Gilbertson (W.) & Co, Limited, Electric Light Engineers, Pontardawe

Gilchrist, Percy Carlyle, Metallurgist, 9, Bridge-st, London, S.W. (*Gilchrist London*)

Giles, Bertram S., Electrical Engineer, c/o Messrs. Mather & Platt, Salford, Manchester. (*Giles c/o Mather Manchester, 556*)

Giles (Frank) & Co, Electric Light Contractors, 50 to 56, and 7, High-st, Kensington, London, W.

GILKES' STEAM ENGRAVING WORKS, Mathematical Dividers, Engravers on Metal, Ivory, &c., Reading, Berks. **See Advt., p. 565**

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Gilkes (Gilbert) & Co, Engineers, and Makers of the "Vortex" Turbine, Canal Iron Works, Kendal, Westmoreland. (*Gilkes Kendal*)

Gill, Alfred, Electric Bell Manufacturer, 1 and 9, Arthur-st West, London, E.C.

Gill & Co., Manufacturing Electricians, 4 & 5, High-st, Oxford

Gill, Frank, District Manager, National Telephone Company, Limited, 1, College-st, Dublin

Gill (J.) & Sons, Reflector and Shade Makers, West House Works, Heckmondwike, Yorks.

Gill & Russell, Tube Makers, Cyclops Tube Works, Walsall (*Tubes Walsall*)

Gillham, Thos, Electric Bell Manufacturer, Kensington Works, Kensington-rd, London, W.

Gillies, Thomas, Electrician, 6, Goulton-rd, Lower Clapton, London, N.E.

Gillingwater, G., Electric Lighting Engineer, 25 Balfour-rd, Highbury New Park, London, N.

Gillmore, G., Electrical Engineer, 10, Athol-st, Douglas Isle of Man

Gilmer (Norman) & Co, Electrical Instrument Makers, Ronald-st, St. Vincent-st, Glasgow

Gilmour, Robert, A.I.E.E., District Manager of the National Telephone Company, 13, Panmure-st, Dundee (*360*)

Gilson, David, Telegraph Instrument Maker, 360, Kingsland-rd, London, N.E.

Gimingham, Edward, Manager of the Edison and Swan United Electric Light Company's Works, Ponder's End, Middlesex; and Stamford House, Northumberland-park, Tottenham, London, N.

Girdlestone, Tatham & Co, Electrical Engineers and Contractors, and Makers of the Andersen Arc Lamp, 16, Davies-st, Berkeley-sq, London, W.

Gisborne, Matthew Babington, Engineer and Machinist, Vulcan Works, Vesey-st, Birmingham

*Gladstone, J. H., D.Sc., F.R.S., 17, Pembridge-sq, London, W.

Glasgow and West of Scotland Technical College, Glasgow. (*For List of Professors, &c., see page 371*)

Glass, John, Agent for Oldfield's Leather Link Belting, 7, Ward's-bldgs, Manchester

Glazebrook, R. T., M.A., F.R.S., Secretary to the British Association Committee on Electrical Standards, Trinity College, and 7, Harvey-rd, Cambridge

Glegg, Alex., Telegraph Engineer (Bowen & Co, Brass and Metal Founders), Phœnix Foundry, Mount Pleasant, London, E.C.

Glew, H. J., Electric Bell Fitter, 39, Museum-st, Bloomsbury, London, W.C.

Glikstein, J., Maker of Electric Wire Casings, 61, Church-st, Shoreditch, E.C., and 56A, Tottenham Court-rd, W.C., London

Globe Electric Company, Limited, Electrical Engineers and Contractors, 12, Ropemaker-st, London, E.C. (A. Parsons, Secretary)
See also page 286.

Globe Engineering Company, Limited, Makers of Steam Engines, 38, Victoria-bldgs, Manchester. (*Globulus Manchester*)

Globe Oil Company, Mineral Lubricating Oil Merchants, 63, Queen Victoria-st, London, E.C.

GLOBE TELEGRAPH AND TRUST COMPANY, Limited, Winchester House, Old Broad-st, London, E.C.
Sir John Pender, G.C.M.G., M.P. Chairman
Sidney Collett ... ... Secretary
See also page 286.

Glover & Hobson, Makers of the Albert Petroleum Engine, St. James's-rd, Old Kent-rd, London, S.E. (*Ironworks London*)

Glover (W. J.) & Co, Wire Rope Manufacturers, St. Helens Wire Mills, St. Helens, Lancs.; and 16, Eastcheap, London, E.C. (*Glover St. Helens, 39*)

GLOVER (W. T.) & CO, Makers of Electric Lighting, Telephone and Telegraph Wires and Cables (insulated and otherwise), Salford, Manchester; and Albany-bldgs, 39, Victoria-st, London, S.W. (*Glovers Salford, 1187; Phonoscope London, 3191*). **See Advt., p. 40**

Glyde, Thomas, Electrical Engineer, St. George's-rd, Freemantle, Southampton

Glynn, H. J., Electrician, Prospect-villa, Mere, Wilts.

Goddard, James & Joseph, Wire Drawers, 68 Tottenham Court-rd, London, W.

Goddard, Massey & Warner, Electric Light Engineers and Contractors, Nottingham

Godfrey, W. B., Electrician, 23, St. Swithin's-lane, London, E.C.

Godiva Engineering Company, Manufacturers of Gas and Oil Engines, Castle-st, Coventry

Golby, F. W., Patent Agent, 36, Chancery-lane, London, W.C.

Gold and Silver Plating Company, Electro Platers, 166, Queen's-rd, Bayswater, London, W. (W. Buck, Manager)

Gold and Silver Recovery Syndicate, Limited, Metal Extractors, &c., 129, St. Vincent-st, Glasgow

Golding, R., Electrical Engineer, Picton Reading Rooms, William Brown-st, Liverpool

Goldstone, Charles, Engineer and Superintendent London and South-Western Railway, Southampton

Goldstone, S., Non-Magnetic Watch Maker, High-st, Manchester; and 62, Holborn-via, London, E.C. (*Chronometer Manchester*

Gomez, Henry, Telephone Receiver Case Maker, 45, Northampton-rd, Clerkenwell, London, E.C.

Goodare, —, Electrician, R. Evans & Co, Haydock, St. Helens

Goodchild, Walter C., Electrical Engineer, Electric Light Department, Midland Railway Company, Leicester

Goodenough, H. T., Electrical Department, Chief Engineer and Superintendent's Office, Great Western Railway, Paddington, London, W.

Goodfellow, Benjamin, Maker of Steam Engines, Hyde, nr Manchester. (*Goodfellow Hyde*)

GOODHAND, T., Steam Engine and Boiler Maker (Small), 37, Paget-st, New Brompton, Kent

Gooding, H. C., Electrical Engineer, Stowmarket

Goodland, W., Engineer and Manufacturing Electrician, Sherborne, Dorset

Goodman, Prof. J., A.M.I.C.E., M.I.M.E., Consulting Engineer, Yorkshire College, Leeds

Goodman & Simpson, Electrical Engineers, 9, Tottenham-st, London, W.

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Goodwin Electrical Engineering Company, Electrical Engineers, 24, Exchequer-st, Dublin. (Robert G. French, Manager)

Goodwin, George A., Wh.Sc., Consulting Engineer, 28, Victoria-st, London, S.W. (*3086*)

GOODWIN (H. G.) & SON, Wood Turners and Pattern Makers, Makers of Ceiling Blocks, Switch Boards, &c, 42 and 43, Kirby-st, Hatton-gdn, London, E.C. **See Advt., p. 647**

Goodwin, James, Electrical Engineer, 3, North-st, Pentonville, London, N.

Goodwin, Robert, Manufacturing Electrician and Electrical Engineer, 24, Exchequer-street, Dublin

Goodyer, F. B., Maker of Electric Light Shades, 155, New Bond-st, and 326, Oxford-st, London, W. (*Esthetic London*)

GOOLDEN (W. T.) & CO, Engineers (Electrical and Mechanical) and Manufacturers, Woodfield Works, Harrow-rd, London, W. (*Dorothea London, 7064*)

*Goolden, W. T., Electrical Engineer, Woodfield Works, Harrow-rd, London, W.

Gordon (C. G.) & Co., Consulting Engineers, Victoria-mansions, Victoria-st, London, S.W.

Gordon Electric Traction Syndicate, Limited, 49, Greenwich-rd, London, S.E. (John Gordon, Managing Director & Secretary)

See also page 287.

Gordon, F. W. Beauchamp, Consulting Electrical Engineer, 4, Park-pl, St. James's, London, S.W.

Gordon (J. E. H.) & Co, Limited—*in liquidation*, (J. D. A. Morris, Suffolk House, Laurence Pountney-hill, London, E.C., Liquidator)

Gordon, J., Electric Traction Engineer, 13, Nettleton-rd, New Cross, London, S.E.

Gordon, William, Electrical Engineer, 17, Jeffrey-st, Camden Town, London, N.W.

*Gore, Dr. G., LL.D., F.R.S., Consulting Chemist, and Electro-Metallurgist, 67, Broad-st, Birmingham

Gorham, J. M., Electrical Engineer, 66, Victoria-st, London, S.W. (*3071*)

Gorman, W. A., Electrical Engineer, Messrs. Siebe, Gorman & Co, 187, Westminster Bridge-rd, London, S.W.

Gorseinon Electric Light Company, Limited, Gorseinon, near Swansea

Goslett (A.) & Co, Electric Bell Manufacturers, 26, Soho-sq, W., and George-yd, Charing Cross-rd, and Cockpit-yd, Little James-st, W.C., London (*Goslett London, 3723*)

Gosling, L. F., Electrician, 21, Selwood-ter, London, S.W.

Gospel Oak Iron Company, Limited, 199, Upper Thames-st, E.C. (*1587*), and 675, Commercial-rd East, E. (*5280*), London; and Wolverhampton (*Gospel London*)

Gossell, Otto (Agent to the Aix-la-Chapelle Iron and Steel Company, Telegraph Wire Manufacturers, 110, Cannon-st, London, E.C. (*1761*)

Gott, J., Consulting Electrician, Commercial Cable Company, 55 and 56, Bishopsgate-street Within, London, E.C., and 6, Lorna-rd, Hove, Sussex

Gott, Wm., Electric Bell Fitter, Keighley, Yorks

Gough, T. J., Electrician, 33, Mosley-st, and Palace of Varieties, Oxford-rd, Manchester

Gourlay, Alex., Electrical Engineer and Contractor, 35, George-st, Stranraer

Goulty, Wallis Rivers, Mechanical Engineer, Wheatley Kirk, Price & Goulty, Albert-chmbrs, Albert-sq, Manchester

Gourock Ropework Company, Wire Rope Manufacturers, 18, Billiter-st, E.C., and Hermitage Steam Wharf, Wapping, E., London; and at Glasgow, Hull, Liverpool, &c. (*Ropework London, 4484*)

Gover, H. Charles, Secretary to the Edison and Swan United Electric Light Company, Limited, and the Swan United Electric Light Company, Limited, 100, Victoria-st, London, S.W. (*Ediswan London, 3146*)

Gowans, James, Electrical Apparatus Maker, 30, Great Sutton-st, London, E.C.

Gowdy, Samuel Henry, Electrical Engineer, 5, Bentinck-villas, Newcastle-on-Tyne

Gower, Dodson & Co., Telegraphic Printing Machine Makers, 25, Old Jewry, London, E.C.

Grafton, Alexander, Consulting Engineer, 113, Cannon-st, London, E.C.

Grafton, Henry, Consulting Engineer, Wardrobe-chmbrs, London, E.C.

Graham, Alfred, Electrical Engineer, 32, De Crespigny-park, Denmark-hill, S.E., and 2, Princes-st, Westminster, S.W., London

Graham & Biddle, Makers of Electric Light Fittings, 463, Oxford-st, and 38, North-row, Grosvenor-sq, London, W. (*3596*)

Graham, D. & G., Electrical Engineers, Clarence Works, Sauchiehall-st, and 134 to 140, Douglas-st (*81*), and 201, Byres-rd, Dowanhill, Partick (*2045*), Glasgow. (*Telephone Glasgow*)

Graham & Morton, Electric Light Engineers and Contractors, King-st, Stirling

Graham, Petchey & Co, Electrical Engineers, 86A, Ford-rd, Roman-rd, London, E.

Graham, R. W., Electrician, Burley Village, Leeds

Graham, William, Wrought-Iron Tube Maker, Aston Tube Works, Birmingham. (*Phone Birmingham*)

Graham, W. J., Electrician, 78, Woodland-terr, Charlton, London, S.E.

Grahame, Henry C., Electrical Engineer, 20, Eastlake-rd, Loughboro' Junction, London, S.E.

Grange Iron Company, Limited, Manufacturers of Electric Lighting Plant, Durham (*Grange Durham*). London Agent: J. H. Taylor 9 and 11, Fenchurch-avenue, London, E.C. (*Tync London, 4108*)

Granger, W. A., Mechanical Engineer, Maker of Granger's Forced Draught for Steam Boilers, 102, Brooke-rd, Stoke Newington, London, N.

Grant, H. F., Electric Light Engineer and Contractor (Messrs. Fanshawe & Grant), 64, Strand, London, W.C.

Grant, J. M., Contractor for the Supply and Erection of Telephones, Milton, Kingussie, N.B.

Grant (J. O.) & Cocks, Electrical Engineers and City Agents of the Electrical Company, Limited, Copthall-house, 46, Copthall-avenue, and 63, Finsbury-pavement, London, E.C.

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Grant (T. C.) & Co, Electricians, Hot Water Engineers, &c., Queen's-rd, Watford

Grant, Thomas B., Electrical Engineer (Messrs. Bourne and Grant), 15, George-st, London, E.C.

Grantham Crank and Iron Company, Limited, Engineers and Boiler Makers, Grantham. (*Land Grantham*)

Granville, W. P., Electrician, 36, Oakfield-rd, Stroud Green, London, N.

Graphite Plumbago Crucible Company, Limited, Plumbago Importers, Tanner's-hill, Deptford, London, S.E. (W. Leathes, Manager)

Grave, Herbert de, Electrical Engineer, 1, Amberley-rd, West-hill, Sydenham, London, S.E.

*Graves, A., Telegraph Engineer, North-Eastern Railway Company, York

Graves, A., Technical Officer, Engineer-in-Chief's Offices, General Post Office, London, E.C.

*Graves, J., Superintendent, Anglo-American Telegraph Company, Valentia, Ireland

Graves (William) & Co, Exporters of Electric Stores, 150, Hope-st, Glasgow. (*Willgraves Glasgow*)

Gravier, Alphonse J., Electrical Engineer, 11, Colby-rd, Upper Norwood, London, S.E.

Gravier Dynamo Syndicate, Limited, Makers of the "Gravier" Dynamo, 11, Colby-rd, Upper Norwood, London, S.E.

*Gray, Prof. A., Professor of Physics, University College of North Wales, Bangor, North Wales

Gray, C. K. E., Limited, Metal Workers and Merchants, Exeter-st, Birmingham

Gray (E.) & Son, Dealers in Tools, Files and Metals for Electricians, 46 and 47, Clerkenwell-green, London, E.C.

Gray, H. & W., Electricians, 81, Stonebridge-rd, Stamford Hill, London, N.

Gray, James H., M.A., B.Sc., Electrical Engineer, Physical Laboratory, The University, Glasgow

Gray, John, B.Sc., A.R.S.M., Electrician, 351, Coldharbour-lane, Brixton, London, S.W.

Gray, James, Secretary, Electric Construction Company, Limited, Queen-street-chmbrs, Queen-st, London, E.C.

Gray (James) & Son, Smiths, Electric Bell Fitters and Electricians, 85, George-st, Edinburgh. (*Grates Edinburgh, 2018*)

Gray (J.) and Son, Electrical Apparatus Makers, New George-st, Sheffield

Gray (J. W.) & Co, Electrical Engineers, 69, Commercial-st, London, E.

Gray (J. W.) & Son, Electricians and Lightning Conductors Manufacturers, 113, Leadenhall-st, London, E.C.

Gray, Matthew, India Rubber, Gutta Percha and Telegraph Works Company, 106, Cannon-st, London, E.C.

Gray, Robert Kaye, India Rubber, Gutta Percha, and Telegraph Works Company, Silvertown, Essex; and 106, Cannon-st, London, E.C. (*Silvergray London, 1726*)

Gray, William E., Electrician, India Rubber, Gutta Percha and Telegraph Works Company, Limited, Silvertown, London, E.

Gray & Palmer, Electric Bell Fitters, 144, King-st, Great Yarmouth

Greathead, James Henry, M.I.C.E., 15, Victoria-st, London, S.W. (Engineer to the City and South London Railway Company, &c.)

GREAT NORTHERN TELEGRAPH COMPANY, 3, St. Helen's-pl, Bishopsgate-st Within, London, E.C. (*Nordiske London.*) Head office: 26, Kongens Nytorv, Copenhagen

Representative in England and Manager in London... ... ...F. C. C. Nielsen.

See also page 287.

Great Western Railway Electric Light Works, 150, Westbourne-ter, Paddington, London, W.

Greaves, W. McG., Consulting Engineer and Inventor of Greaves' Boiler Furnace, 6, Fountain-st, Manchester

Greeff (R. W.) & Co, Acid and Chemical Merchants, 29, Mincing-lane, London, E.C.

Green, Bernard, Electrician, 1, Elm Tree-ter, Cockermouth

Green & Boulding, Electrical Engineers, 21, Featherstone-st, City-rd, London, E.C. (*Temperature London*)

Green (E.) & Son, Limited, Engineers and Makers of Green's Economisers, 2, Exchange-st, Manchester; and Wakefield (*Economiser Manchester*)

Green, G. W., A.M.I.C.E., Electrician, Messrs. Muirhead & Co, 2, Princes-st, Westminster, London, S.W.

Green (Jas.) & Nephew, Electrolier Manufacturers, 107, Queen Victoria-st, London, E.C. (*Porcelain London, 1767*)

Green, L. M., Electrician, Bryn House, Dolgelly, N. Wales

Green (Ralph) & Co, Electrical Apparatus Makers, 4, Pearson-pl, Bute Docks, Cardiff

Green, R., Electrician, Victoria-rd, Wargrave, near Twyford, Berks.

Green, S. A., Electrician, 6, Edith-rd, Chandos-rd, Stratford, London, E.

Green (Thomas) & Son, Limited, Engineers, Smithfield Iron Works, Leeds; and Surrey Works, Blackfriars-rd, London, S.E. (*Smithfield Leeds, 158; Surrey Works London*)

Green & Treacher, Manufacturing Electricians and Electrical Engineers, 77, Cannon-st, and (Works) Old-st, London, E.C.

Green, William, Mathematical Instrument Maker, 5, Mount-pleasant, Clerkenwell, London, W.C.

Green (W.) & Son, Makers of Dynamo Brushes, Wire Weavers, &c., 98, Albany-rd, London, S.E.

Greene (H.) & Sons, Electrolier Manufacturers, 153 and 155, Cannon-st, and 25, Bush-lane, Cannon-st, London, E.C. (*Luminosity London*)

Greener, Arnold K., Electrical Engineer, Oxford Electric Company, 45, Broad-st, Oxford

*Greener, J. H., M.I.E.E., Telegraph Engineer and Electrician, 15, Walbrook, E.C., and "Kurneh," Deronda-rd, Herne-hill, S.E., London. (*Occultness London*)

Greener, W. B., Electrical Engineer, Knutsford-rd, Grappenhall-rd, near Warrington

Greenhalgh, William, Electrical Engineer, 29 Carlton-st, Leeds

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*GREENHILL, J. H., Dynamo Manufacturer and Electric Light Engineer, (New) King-st, and Fortwilliam-park, Antrim-rd, Belfast. (*Vermont Belfast, 419*) **See Advt., p. 37**

Greenhill, Matthew C., Electrical Engineer, 504, Mansion House-chmbrs, 11, Queen Victoria-st, London, E.C.

Greening, G., Dealer in Electrical Supplies, Albion-ct, Bradford

Greening (N.) & Sons, Limited, Wire Manufacturers & Metal Perforators, Warrington. (*Greenings Warrington 15*)

Greenwich Electrical Works, Manufacturing Electricians, 6, Nelson-st, Greenwich, London, S.E.

Greenwood, Arthur, M.I.C.E., Consulting Engineer, Albion Works, Armley-rd, Leeds (*Greenwood Leeds*)

Greenwood & Batley, Limited, Electrical and Mechanical Engineers, Albion Works, Armley-rd, Leeds; and 16, Great George-st, London, S.W. (*Greenwood Leeds*)

See also page 287.

Greenwood, James, Electro-Chemist, 35, Queen Victoria-st, London, E.C.

Greenwood (Luke) & Co, Manufacturers of Electrical Apparatus, Trafalgar Works, Rochdale, Lancs.

Gresham & Craven, Limited, Engineers and Makers of the "Gresham" Injectors and Ejectors, Craven Iron Works, Ordsall-lane, Manchester. (*Brake Manchester, 613*)

Grey & Marten, Lead Manufacturers and Metal Merchants, City Lead Works, New Park-st, Southwark Bridge, London, S.E. (*Amalgam London, 4750*)

Grice, Grice, & Son, Brass and Copper Tube Manufacturers, Sheepcote-st, Birmingham; and 112, Fenchurch-st, London, E.C. (*Grice Birmingham*)

Grieve (John) & Co, Manufacturers of Hydraulic and Electric Cranes, Motherwell, Glasgow. (*Grieve Motherwell*)

Griffin (C.) & Co, Limited, Technical Publishers, 12, Exeter-st, Strand, London, W.C.

Griffin (John J.) & Sons, Limited, Electrical Apparatus Makers, 22, Garrick-st, Covent Garden, and 2, Long-acre, London, W.C.

Griffin (S.) & Co., Makers of the Griffin Gas and Petroleum Engine, Kingston Iron Works, Ambury, Bath

Speciality: High-speed Oil Engines for Electric Lighting and Boat Propulsion.

Griffith (G. D.) & Co, Electrical Engineers and Wiring Contractors, Richmond, Surrey

Griffiths, Albert, Electrician, Oak Hill House, Waterhouses, Ashton-under-Lyne

GRIFFITHS BROS. & CO, Paint, Enamel, Lacquer, and Varnish Manufacturers. Inventors and Sole Makers of "Anti-Sulphuric Enamel," Flexible Insulating Shellac Varnish, and other Specialities for the Electrical Trade. Macks-rd, Bermondsey, London, S.E. (*Aquol London, 4807*) **See Advt., p. 550**

Griffiths, E. H., Electrician, 12, Park-side, Cambridge

Grimshaw, C. O., Electrical Engineer, Westminster Electric Supply Corporation, Limited, Central Station, Eccleston-pl, London, S.W.

Grindle, G. A., Works Manager of the Chloride Electrical Storage Syndicate, Limited, Clifton Junction, near Manchester; and Addiscombe, Prestwich, Lancs. (*Accumulate Pendlebury*)

Grindley & Co, Coal Pitch Manufacturers, Upper North-st, Poplar, London, E. (*Grindley Poplar London, 5058*)

Grindrod, J. K., Electrical Engineer and Contractor, Oulder Hill, Rochdale

Gripper, Francis E., Electrician, 19, Great George-st, Westminster, London, S.W.

Grist (Charles James) & Co., Electrical Engineers and Contractors, 16, Eastcheap, London, E.C.; and 61, Piccadilly, Manchester. (*Affixtures London*)

Grittan, Joseph, Electrician, 97, Highbury-quadrant, London, N.

Griuyer, George, Ships' Telegraph Engineer, 63, White Horse-st, London, E.

Grob (J. M.) & Co, Makers of Patent Oil and Gas Engines, 18, Dufferin-st, London, E.C. (*Petroline London*)

Groombridge & South, Electric Motor Manufacturers, 40, New Bond-st, London, W.

Gross (Charles) & Co, Chemical Merchants, 9, Mincing-lane, London, E.C. (*2158*)

Grove, A. S., Electrical Engineer, Thompson, Ritchie & Co, Limited, 48, James-st, Buckingham Gate, London, S.W. (*Farad London, 3208*)

Grove, Charles E., Electrical Engineer, Thames Iron Works, Orchard-yd, Blackwall, London, E. (*Thames London, 5048*)

Grove, E. P., Electrician, 5, South-parade, Chelsea, London, S.W.

Grover & Grover, Makers of Electric Light Wire Casings, Kentish Town Wharf, Kentish Town, N.W., and 94, Mount-st, Bethnal Green, E., London

Grover, Col. George E., R.E., United Service Club, Pall Mall, London, S.W.

Groves (Richard) & Sons, Engineers' Tool Makers, Beehive Works, Sheffield

Groves, W., Electrical Apparatus Maker, 89, Bolsover-st, Fitzroy-sq, London, W.

Grubb, Weston, Electric Bell Fitter, 83, Blackstock-rd, London, N.

Grunbaum (L. N.) & Son, Manufacturers and Importers of Ozokerite, 84, Leadenhall-st, London, E.C. (*Ozonometer London*)

Grundy, A., Electrical Engineer, Baily and Grundy (London), Limited, Amberley Works, Paddington, London, W.

Guernsey Electric Railway Company, Limited, 34, High-st, Guernsey. (T. B. Brown, Secretary)

Guest, W. H., Electrician, Sevenoaks, Kent

Guilbert-Martin, George, Glass Manufacturer, 1 and 2, Falcon-st, London, E.C. (*Photophore London*)

Gulcher (New) Electric Light and Power Company, Limited, Electric Light Engineers and Contractors, Battersea Foundry, Battersea, S.W. (*9010*); 139, Queen Victoria-st, London, E.C. (*15057*); and 93, Hope-st, Glasgow (*Gülcher London*)

D. de Castro ... ... Chairman
T. C. Morgan ... ... Secretary

See also page 287.

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Gullette, Wm. L., Electrical Engineer (Messrs. Turvey & Gullette), 1, White Horse-alley, Cowcross-st, London, E.C.

Gümpel, C. Godfrey, Electrician, 70, Newman-st, W., and 22, Christchurch-rd, Streatham Hill, S.W., London

Gunn, F., Electrical Engineer, Corporation Art Gallery, Mosley-st, Manchester

Günther, W., Maker of Turbines, Central Engineering Works, Oldham, Lancs. (*Günther Oldham*)

Guthrie (James) & Co, Manufacturers of Electric Fittings in Wrought Iron, Copper and Brass, 9, Leather-lane, and 117, Holborn, London, E.C.

Guthrie (J. B.) & Son, Iron and Steel Merchants, and Dealers in Belting and Machinery, 70 and 71, Bishopsgate-st Within, London, E.C. (*Busiris London, 1435*)

Gutta Percha Company, The, 18, Wharf-rd, City-rd, London, N. (*Guttapercha London, 11441*)

Guttmann, Oscar, Consulting Engineer for Explosives, Dunster House, Dunster-court, Mark-lane, London, E.C.

Guy, Arthur F., Electrical Engineer, Electric Light Branch, G.P.O. East, St. Martin's-le-Grand, London, E.C.

Guy, F. A., Electrical Engineer, 349, Liverpool-rd, London, N.

Guy, G., Electrician, 11, Lismore-rd, Haverstock Hill, London, N.W.

Guy (H. Augustus) & Co, Makers of Improved Magnet Steel, Invincible Steel Works, Smithfield, Sheffield

Guy, W., Electrical Engineer, Waterloo Grain Warehouses, Waterloo Dock, Liverpool

Gwyn, A. S. W., Engineer and Agent for Messrs. Joseph Booth & Bros, 114A, Queen Victoria st, London, E.C. (*Asunder London*)

Gwynne & Co, Electrical, Hydraulic and Mechanical Engineers, Brooke-street Works, Holborn, London, E.C. (Rankin Kennedy, Manager Electrical Department) (*Gwynnearam London, 2698*)

Gwynne, J. & H., High-Speed Steam Engine Makers, 89, Cannon-st, E.C. (*1544*); and Hammersmith Iron Works, London, W. (*8788*) (*Gwynne London*)

Gye, Percy, Electrical Engineer, 99, Inverness-terrace, Hyde Park, London, W.

— H —

Haagen (T. H.), Son & Co, Leather Belting Manufacturers, 60, St. Mary-axe, London, E.C.

Habgood (W.) & Co, Electrical Engineers, Makers of the Davy Arc Lamp, 49, Queen Victoria-st, London, E.C.

Hacking, C. L., Electric Light Engineer and Contractor, 259, King's-rd, Chelsea, London, S.W.

Hackworth (John H.) & Co, Engineers and Contractors for Machinery, Plant, &c, 46, Queen Victoria-st, London, E.C. (*Plant London*)

Haddan (J. Herbert) & Co, Patent Agents, 18, Buckingham-st, Strand, London, W.C.

Haden (G. N.) & Son, Engineers, 4, Albert-sq, and 23, Bank-st, Red Bank, Manchester. (*Haden Manchester*)

Haddon & Co, Electrical Engineers, 127, Bothwell-st, Glasgow

Hadfield, R. A., Metallurgical Engineer, President Sheffield Technical Metallurgy Society, Hecla Works, Sheffield. (*Hadfield Sheffield*)

Hadfield's Steel Foundry Company, Limited, Steel Founders, Hecla Works, Sheffield; and 156 and 157, Leadenhall-st, London, E.C. (*Hadfield Sheffield; Requisition London*)

Manufacturers of Steel Castings for Electricians equal to Wrought Iron in magnetic permeability.

Hager, C. W., Electrician, Siemens Bros & Co, Ltd, Woolwich, London, S.E.

Haggie Bros, Lightning Conductor Manufacturers, Gateshead-on-Tyne; and 113, Fenchurch-st, London, E.C. (*Haggie Gateshead*)

Haggie, D. H. & G., Patent Round and Flat Iron and Steel Wire Rope Manufacturers, Sunderland; and 57, Gracechurch-st, London, E.C. (*Haggie Sunderland; Minutely London*)

HAGGIE (R. HOOD) & SON, Wire Rope Manufacturers, Queen-st, Newcastle-on-Tyne; 35, Lime-st, London, E.C.; and at Cardiff, Hull, North Shields, &c. (*Haggie Newcastle-on-Tyne; Haggie London*)

Haggie, R. H., Electrical Engineer, Blythswood Works, Newcastle-on-Tyne

Hagues, Tom, Electrician, Rotherwood Iron and Steel Company, Sheffield

Haig, H. de H., Captain, R.E., Consulting Electrician, Westfield House, Benwell, Newcastle-upon-Tyne.

Haigh & Co, Engineers' Tools Makers, Bowling Green Tool Works, Halifax (*Verax Halifax, 152*)

Hailey & Co, Electrical Apparatus Manufacturers, 26, Sloane-st, 36, Gloucester-rd, and North-st, Sloane-st, London, S.W.

Haine & Co, Electricians, 29, Hereford-rd, Bayswater, London, W.

Haines, Robert, Electrical Engineer, 45, St. John-st, Smithfield, London, E.C.

Hale, H. G., Electrical Engineer, 37, High-st, Grantham

Halford, Thomas Ernest, Electrician, 11, Furnival-st, Holborn, London, E.C.

Halhead, J. A., Manufacturing Electrician, Currock, Carlisle. (*Halhead Carlisle*)

HALIFAX & BERMUDAS CABLE COMPANY, Limited, 33, Old Broad-st, London, E.C.

T. Skinner ... ... Chairman
Joseph Rippon ... ... General Manager
See also page 287.

Halifax Mutual Electric Light & Power Company, Limited *in liquidation*. (W. D. Taylor, Town Hall-bldgs, Halifax, Liquidator)

Hall (A.) & Co, Electric Light Engineers and Contractors, 1 and 11, South John-st, Liverpool.

Hall, Beddall & Co, Electric Light Contractors, Pitfield Wharf, Commercial-rd, Lambeth, S.E., and 31, Bread-st, E.C., London

Hall, Charles, Electrical Engineer, Redhill, Surrey

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Hall, C. J., Electrical Engineer, Leeds and London Electrical Engineering Company, Ltd., Steam Plough Works, Leeds

Hall, E. A., Electrician, Walker Bros, Pagefield Iron Works, Wigan

Hallam (G.) & Co, Steel Wire Manufacturers and Drawers, Havelock Wire Mills, Owlerton, Sheffield

Hall, C. F. N., Engineer and Electrician, Victoria Works, Crockett's-lane, Smethwick

Hall, H. Cuthbert, Consulting Electrical Engineer, Editor of *Electrical Plant and Electrical Industry*, 52, Queen Victoria-st, London, E.C.; and Eversley, Elmfield-rd, Bromley, Kent

Hall, H. E., Electrical Engineer, 1, Anley-rd, West Kensington Park, London, W.

Hall, J. & E., Limited, Engineers, Boiler Makers, Iron and Brass Founders, &c., Dartford, Kent; and 23, St. Swithin's-lane, London, E.C. (*Hallford Dartford*; *Hallford London, 1876*)

Hall, J. L., Electrical Engineer, 5, Shandon-cres, Merchiston, Edinburgh

Hall, J., Electrical Engineer, Messrs. W. T. Henley's Telegraph Works Company, Ltd., 27, Martin's-lane, Cannon-st, London, E.C.

Hall, J. P.) & Co, Electrical and General Engineers, Blackriding Iron Works, Werneth, Oldham. (*Dynamo Oldham, 65*)

Hall, J. P., Electrical Engineer, Gorse Bank, Werneth, Oldham. (*Hall Gorsebank Oldham, 6580*)

Hall & Kay, Engineers, Stockport and Ashton-under-Lyne

Hall (Matthew) & Co, Electrical Engineers, 88, Wigmore-st, and 9 and 11, Bulstrode-mews, London, W.

Hall Street Metal Rolling Company, German Silver Wire Manufacturers, Hall st Works (*4108*), and Western-road Rolling Mills (*4122*), Birmingham. (*Bissaker Birmingham*)

Hall, William, Copper, Lead, &c., Merchant, 87 and 89, Winstanley-rd, Battersea, London, S.W.

Hall-Brown, Buttery & Co, Makers of Steam Engines for Electric Lighting Purposes, Helen-street Engine Works, Govan, Glasgow; and 36, Leadenhall-st, London, E.C. (*Triple Glasgow, 1845*)

Hallett & Fry, Antimony Refiners, 202, Rotherhithe-st, London, S.E. (*Autotype London*)

Hallows, F., Electrician, 37, Stockwell Park-crescent, London, S.W.

Halls, Arthur, Lathe and Tool Maker, Tool Works, Cobholm, Great Yarmouth

Halpin, Druitt, M.I.C.E., Consulting Engineer, 17, Victoria-street, Westminster, London, S.W.

Hamilton (Claud) & Co, Electric Light Engineers, 137, Waterloo-st, Glasgow

Hamilton, Griffin & Co, Limited, Electrical Agents, 72, Bishopsgate-st Within, London, E.C.

Hamilton (J.) & Son, Electrical Engineers, Guildford-st, Chertsey

Hammond, Robert, Consulting Electrical Engineer, 117, Bishopsgate-street, London, E.C. (*Hammond London, 1304*)

Hampson, R. S., Telegraph Superintendent, Manchester, Sheffield, and Lincolnshire Railway, Godley Junction

Hampton, Edwin, Ltd., Electrical and General Engineers, Frogmore-st, Abergavenny

Hampton & Sons, Electric Light Engineers, Makers of Electroliers, &c., Pall Mall East, and Cockspur-st, Charing Cross, S.W., 2, 4 and 6, Witcomb-st, W.C., and (Works) Belvedere-road, Lambeth, S.E., London (*3506*)

Hancock, C. E., Electrical Engineer, 3, Peter's-ct, St. Martin's lane, W.C., and 3, Inkerman-ter, Kensington, S.W., London

Hancock & Hulbert, Steam Carbon Cutters and Carbon Plate Makers, 12, Richmond-pl, New-rd, Wandsworth-rd, London, S.W.

Hancock, James Lyne, Maker of Vulcanised India Rubber Goods, 256, Goswell-rd, and 55-61, Moreland-st, City-rd, London, E.C.

Hancock & Rixon, Electric Light Engineers, 52, Great Marlborough-st, London, W.

Hancock, Walter, M.I.E.E., 10, Upper Chadwell-st, Myddleton-sq, London, E.C.

Hancocks, Stuart Mortlock, Electrician, Broomy Hill, Hereford

Handcock, H. W., Electrical Engineer, 5, Victoria-st, London, S.W.

Handley, Arthur, A.I.E.E., Electrician, Messrs. D. & G. Graham, Clarence Works, Glasgow

Hands (Alfred) & Co, Electrical Engineers, 113, Leadenhall-st, London, E.C.

Handyside (Andrew) & Co, Limited, Engineers and Ironfounders, 104, Queen Victoria-st, London, E.C.; and Britannia Iron Works, Derby. (*Handyside London, 1969*; *Handyside Derby*)

Hannan & Buchanan, Salinometer, Thermometer, Lever Clock, and Engine Indicator Manufacturers, 75, Robertson-lane, Glasgow

Hannay Electrolytic Gold Extraction Syndicate, Limited, Electro-Chemists and Metallurgists, Portland House, Basinghall-st, London, E.C.

Hannay, J. B., Electro-Metallurgist, Cove Castle, Dunbartonshire, N.B.; and Whitehall Club, Parliament-st, London, S.W.

Hanover Caoutchouc, Gutta Percha and Telegraph Works, 57, Basinghall-st, London, E.C. (J. D. Gilbert, Agent). (*Playfet London.*)

Hanover Vulcanite Company, Vulcanite Manufacturers, Moorgate Station-bldgs, 63, Finsbury-pavement, London, E.C.

Hanson, Albert, Electrical Engineer, Thornleigh, Apperley Bridge, Leeds (*Hanson Apperley Bridge*)

Hanson, Luther, Electrician, Mayfield Cottage, Marlpool-lane, Kidderminster

Harben, Alfred, Electrician, Millerfield, Humber-rd, Westcombe-park, London, S.E.

Harbord, Henry, Machine Band Maker, Millstream Leather Works, Millstream-rd, Dockhead, London, S.E.

HARBURG INDIA RUBBER C. COMPANY (F. Winter, Agent), Ebonite and Vulcanite Manufacturers, 138, London-wall, London, E.C. **See Advts., pp. 471, 575, and 642**

Harburg and Vienna India Rubber Company 9 to 14, Tower-chmbrs, Moorgate-street, London-wall, London, E.C.

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Harcourt. A. G. Vernon, M.A., LL.D., F.R.S., F.C.S. (General Secretary, British Association), Cowley Grange, Oxford

Harcourt, Thomas, Electrician, Fords Water, Zeal, Wilts.

Hardaker, W., Electrographer, 23, Cursitor-st, London, E.C.

Hardcastle, W. H., Influence Machine Maker, 172, Alexandra-rd, Sheffield

Harding, Cocks & Co, India Rubber Manufacturers, 29, Jewry-st, London, E.C.

Harding (George) & Sons, Wire Workers, 25 to 36, Long-lane, Borough, and 19A, Tabard-st, London, S.E. (*Tinworks London, 4689*)

Harding (T. R.) & Son, Limited, Counter and Speed Indicator Makers, Tower Works, Leeds. (*Porcupine Leeds, 11533*)

Hardingham, G. G. M., Inst.M.E., Assoc.M.Inst. C.E., Fel.Ch.Inst.P.A., Consulting Engineer and Chartered Patent Agent, 191, Fleet-st, London, E.C. (*Hardingham London*)

Hardman, Powell & Co, Electric Light Fittings Manufacturers, King Edward's-rd, Birmingham; and Bloomsbury-mansions, Hart-st, London, W.C.

Hardt, M. P., Electrical Engineer, 63, Queen Victoria-st, London, E.C.

Hardtmuth (F.) & Co, Carbon Makers, 12, Golden-lane, London, E.C. (*Hardtmuth London, 476*)

Hardy, John T., Electrical Engineer, 38, Union-st South, Halifax

Hardy Patent Pick Company, Limited, Engineering and General Tool Makers and Dealers, 15, Walbrook, London, E.C. (*1918*); and Heeley, Sheffield. (*Hardypick Sheffield*)

Hare & Co, Limited, Draughtsmen and Engravers on Wood, Photo-Etchers and Photo-Lithographers, 31, Essex-st, Strand, W.C., and 7, Bride-court, E.C., London. (*Woodpeckers London*)

Harfield & Co, Limited, Mechanical and Electrical Engineers, Mansion House-bldgs, Queen Victoria-st, London, E.C. (*Harfield London*)

Harford and Bristol Brass Company, Brass and Copper Wire Manufacturers, Golden Hart Wharf, Dowgate, Upper Thames-st, London, E.C. (*Redrutin London, 1790*); and Keynsham, near Bristol

Harford, Geo. J., Practical and Consulting Electrical Engineer, 36, Bath-st, Southport

Harger Bros, Makers of Electric Light Casings and Mouldings, Settle, Yorks.

Harker, J. D., Electrical Engineer, 78, King-st, Manchester

Harkness, William, Analytical Chemist, Somerset House Laboratory, Strand, London, W.C.

Harland & Wolff, Shipbuilders and Engineers, Belfast. (*Harland Belfast*)

Harling, W. H., Mathematical Instrument Maker, 47, Finsbury-pavement, London, E.C. (*Clinograph London*).

Harold & Co., Telegraph and Electric Light Contractors, 30 and 31, St. Swithin's-lane, E.C., London (*Symbolize London*)

Harper (J.) & Co, Limited, Manufacturers of Malleable Iron Castings, Albion Works, Willenhall, Staffs, and 133 and 135, Finsbury Pavement, London, E.C. (*Harpers Willenhall*).

Harper, R. R., Telegraph Engineer, Sash-court, Wilson-st., E.C.; and 4, Heybourn-ter, Willoughby-lane, Tottenham, London, N.

Harpers, Limited, Makers of Shafting, Belt Pulleys, Rope Pulleys, Gear Wheels, &c, Albion Iron Works, Aberdeen (*Harpers Aberdeen*)

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Harris, A., Electrician, 4, Crouch-hill, London, N.

Harris (A. E.) & Co, Makers of Springs for Pushes and Special Stampings for the Trade, 95, Camden-st, Birmingham

Harris, A. J. S., Electrical and Mechanical Engineer, 85, Hazlehurst-rd, Manningham, Bradford

Harris, H. Graham, M.I.E.E., Consulting Electrical Engineer, Bramwell & Harris, 5, Great George-st, London, S.W. (*Willbram London, 3050*)

Harris, H., Electrical Agent, 254, King-st, Ravenscourt Park, London, W.

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Harris, Thomas A., Electrical Engineer, Phœnix Works, Collingwood-st, London, S.E.

Harris (T.) & Son, Makers of Electric Light Fittings, Wine-st, Bristol

Harris, W., Electrician, 29, Lockington-rd, Battersea Park-rd, London, S.W.

Harris, W. J., Mathematical Instrument Maker, 91, Shadwell-st, Birmingham

Harrison, Ainslie & Co, Limited, Engineers, Founders and Smelters, 23, Abingdon-st, Westminster, London, S.W.

Harrison, A. F., Electrical Engineer, West Lexham, Swaffham, Norfolk

Harrison, A., Limited, Makers of Electric Light Wire Casings, Hardwood Turning Mills, Bankhall, Liverpool. (*Lathe Liverpool, 3775*)

Harrison, Coles & Co, Electricians and Engineers, Hermitage Electrical Works, Richmond, Surrey, and 20, Kensington-court-place, London, S.W.

Harrison, F., Electrical Engineer (E. L. Berry, Harrison and Co.), Lyric-chmbrs, Whitcomb-st, London, W. (*Kathode London*)

Harrison, F. O., Electrical Engineer, Galway Electric Company, Newtownsmyth, Galway

Harrison, George, Brass and Copper Wire Manufacturer, 182, Drury-lane, London, W.C.

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HARRISON, HAYDN T., Electrical Engineer (Nalder and Harrison), Trafalgar House, Great Newport-st, Charing Cross-rd, London, W.C. **See Advt., p. 523**

Harrison, Hugh Erat, B.Sc., Electrical Engineer, Faraday House, Charing Cross-rd, London, W.C.

Harrison, R. H., Electrician, Scientific Works, Bridgnorth, Salop

Harrison & Sons, Publishers of the *London Gazette*, &c., 45, 46 and 47, St. Martin's-lane, London, W.C. (*3741*)

Harrison, Thos. H., Consulting Electrical Engineer, Belle Vue, The Grove, Wandsworth, London, S.W.

Harrison, W. E., Manufacturer and Erector of Lightning Conductors, Steeplejack Works, Sheffield (*Steeplejack Sheffield, 561*)

Harrison (Wm.) & Co, Mica and Talc Merchants, 16, Mincing-lane, London, E.C.

Harriss, G. M., Electrical Engineer, Central Electric Light and Power Station, Bray, Ireland

Harrow & Co, Electrical Engineers, 13 and 14, Portland-st, Soho, London, W.

Harrower, Peter, Exporter of Electrical and Telegraph Plant, 134, Bath-st, and 136, Cowcadden-st, Glasgow. (*Harrower Glasgow, 1191*)

Hart, Francis G., Electric Light Engineer, 28, Victoria-street, London, S.W. (*Entropy London*)

Hart, F. W., Chemical Appliance Maker, 96, Stoke Newington-rd, London, N.

Hart, H. C., 1st Class Technical Officer, General Post Office, London, E.C.

Hart, James H., Electrician, 11, Glycena-rd, Lavender-hill, London, S.W.

Hart, Son, Peard & Co, Ironmongers and Manufacturers of Electric Light Fittings, Lightning Conductors, and Art Metal Work, 88 to 91, Drury-lane, Strand, W.C., London; and Grosvenor Works, Birmingham

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Hartill, Alfred J., Electric Light Engineer and Contractor, 4, Worcester-st, Wolverhampton

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Hartvigson, L. L., Electrician, Great Northern Telegraph Company, 3, St. Helen's-pl, London, E.C.

Harvey & Co, Limited, Engineers, Hayle and Falmouth, Cornwall; and 186-188, Gresham-house, Old Broad-st, London, E.C. (*Harvey Hayle; Harvey Falmouth; Carnsew London*)

Harvey, Ernest W., Consulting Engineer, c/o Mr. Frederick Siemens, 10, Queen Anne's-gate, London, S.W.

Harvey, G., Electrician, 87, Dean-st, Soho, London, W.C.

Harvey, Henry S., Electrician, Percy Villa, Maryon-rd, Charlton, Kent

Harvey & Peak, Electrical Instrument Makers, 56, Charing Cross-rd, London, W.

Harvey Steel Company of Great Britain, Limited, Steel Founders, Machinists, &c., 23, Victoria-st, London, S.W.

Harvie (Wm.) & Co, Limited, Electrical Engineers, 222, Broomielaw, and 24, M'Alpine-st., Glasgow. (*Broomielaw Glasgow, 945*)

Hasdell, H. D., Electrician, Post Office Savings Bank, Queen Victoria-st, London, E.C.

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Haseltine, Lake & Co, Patent Agents, 45, Southampton-bldgs, Chancery-lane, London, W.C. (*Scopo London*)

Haskell, E., Paper and Silk Shade Maker for the Electric Light, 18, Baker-st, Portman-sq, London, W.

Haslam, A. P., Electrician, 81, St. Dunstan's-rd, Hammersmith, London, W.

Haslam, T. J., Electrician, Altadore, Glenageary, Kingstown, co. Dublin

Hastie (John) & Co, Engineers, Kilblain Engine Works, Nicholson-st, Greenock. (*Hastie Greenock, 133*)

Hastings and St. Leonards-on-Sea Electric Light Company, Limited. Works and Offices, Earl-street, Hastings

H. M. Baker, J.P. ... ... Chairman
M. G. Ross ... ... Manager
F. E. Burton ... ... Secretary

See also page 287.

HATCH, GEORGE, Iron, Steel and Tool Merchant, Crown Wharf, 5, Upper Thames-st, London, E.C. (*George Hatch London*)

Hathorn, Davey & Co, Electrical Engineers, Sun Foundry, Leeds; and 3, Princes-st, Westminster, London, S.W. (*Hathorn Leeds*)

Hatt, J. J., Electrical Engineer, 4, St. Mary's-ter, Maida-hill, London, W.

Hattersley & Davidson, Electrical Engineers, (Agents for Messrs. Rosling & Matthews), Sheffield

Hatton Engineering Company, Makers of Castings, Forgings, &c., for Electricians, Baldwin's-gdns, Gray's Inn-rd, London W.C.

Haughton (Thomas) & Co, Consulting Engineers, 110, Cannon-st, London, E.C. (*Haughnot London*)

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Hawkings, —, Electrical Engineer, Acre House, Bachelor's Acre, Windsor

Hawkins, Alex., Electric Bell Manufacturer, &c., 126 to 128, London-rd, London, S.E. (*Alexander Hawkins London*)

Hawkins Bros & Co, Brass and Copper Wire Manufacturers, Enterprise Works, Bowling Green-lane, Farringdon-rd, London, E.C. (*Feudatory London*)

Hawkins, Charles C., M.A., Electrical Engineer, 15, Great College st, Westminster, London, S.W.

Hawkins, E., Electrical Engineer, The Lodge, Newton-le-Willows, R.S.O., near Bedale, Yorks.

Hawkins, George William, Electric Bell Fitter, 1, Ealing-rd, Ealing, London, W.

Hawkins, T., Manager of the Newton Electrical Engineering Works, Taunton

Hawksley, Thos. & Chas., Consulting Engineers, 30, Great George-st, London, S.W.

Hawksley, Wild & Co, Engineers, Makers of Feed-Water Heaters, &c., Saville-st East, Sheffield; and 5, Laurence Pountney-hill, London, E.C. (*Ferric London*)

Hawley, James, Manufacturer of Electrical Apparatus, Derby Works, Carruthers-st, Vauxhall, Liverpool

Hawtayne, W. C. C., Electrical Engineer, 3, Prince's-mansions, Victoria-st, London, S.W.

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Hay, Alfred, Demonstrator in Electrical Engineering, at the University College, Nottingham

Haybridge Iron Company, Limited, Iron Wire Makers, Wellington, Salop. (*Haybridge Hadley Salop.*) London Agents: Brooker, Dore & Co, 4, Corbet-court, Gracechurch-st, London, E.C. (*Brooker London, 11064*)

Haycraft, H. C., Electrician, City and Guilds of London Institute, Exhibition-rd, London, S.W.

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Hayne, Richard W., Electrician and Electrical and Telephone Engineer, 6, Normand-mansions, West Kensington, London, W.

Hayne, W. E., A.I.E.E., Electrical Engineer and Contractor, 29, Western-rd, Brighton; and 12, Ella-rd, Crouch Hill, London, N.

*Haynes, F. T. J., Telegraph Engineer, Swindon, West of England and South Wales Division Great Western Railway, Taunton

Hayward, A. C. Curtis—*see* Curtis-Hayward, A.C.

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Headech, E. T., Electrician, Inventor of the Headech Arc Lamp, 61, Falmouth-rd, New Kent-rd, London, S.E.

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Headworth, H. Hugh, Electric Bell Fitter, 191, High-st, Poplar, London, E.

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Heaphy, Musgrave, C.E., F.G.S., M.I.E.E., 18, Lombard-st, London, E.C.

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Heap, J. A., Electro-Chemist, 15, Corinne-rd, Tufnell Park, London, N.

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*Hedges, Killingworth, M.I.C.E., Consulting Electric Light Engineer, 7, Carteret st, and 92, Victoria-st, London, S.W.

Hedgman, Elward Radford, Electrical Engineer, 23, Castle-st, Falcon-sq, London, E.C.

Heenan & Froude, Electrical Engineers and Contractors, Newton Heath Iron Works, near Manchester; Aston Works, Aston, Birmingham; The Tower Works, Wembley, near London; and 4, Chapel Walks, Manchester. (*Spherical Newton Heath, Spherical Birmingham; Tower Wembley; Heenan Manchester, 966*)

Heenan, W. E., Electrical Engineer, Northampton Electric Light and Power Company, Angel-lane, Northampton

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Henderson (H. A.) & Co, Electrical Engineers 3, Chapman-st, Hulme, Manchester

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Henderson, Osbert, Electric Light Contractor, 105, 107 and 111, Union-st, Glasgow. (*4519*)

Henderson, Thomas, Engineer, Patentee of Mechanical Furnaces and Stokers, 6 and 8, Trueman-st, Liverpool. (*Mechanical Liverpool*)

Hendrick, J., Electric LightEngineer and Electric Bell Fitter, Lower Pembroke-st, Dublin

Henley's (W. T.) Telegraph Works Company, Limited, Wire and Cable Makers, &c., 27, Martin's-lane, Cannon-st, London, E.C. Works: North Woolwich (G. Sutton, Man. Director. (*Henley's Works London, 1734*). *See also page 287.*

Henry, —, Electrical Engineer, 53, Stanbury-rd, Lugard-rd, Peckham, London, S.E.

Henton, A. E., Mechanical and Electrical Engineer, 35, Harrow-rd, Paddington, London, W.

Henton, F. W., Electrical Engineer, 249, Tufnell Park-rd, London, N.W.

Hepburn & Gale, Limited, Leather Driving Band Makers, 239, Long-lane, Southwark, London, S.E. (*Bellingale London*)

Hepworth, J., Engineer and Manager of the Corporation Gas and Water Works, Carlisle. (*Hepworth Carlisle 1063*)

Herbert, Alfred, Manufacturer of Tools and Special Machinery, Coventry. (*Lathe Coventry, 77*)

Herbert, E. A., Electrician, 7, Humber-rd, Westcombe Park, London, S.E.

Herbert, Ernest G., Electrician, Aysgarth, Calverley Park-gardens, Tunbridge Wells, Kent

Herbert, Geo., Electrician, 46, Brooksby-st, Barnsbury, London, W.

Herculite and Electrical Manufacturing Company, Limited, 28B, Bower-rd., Victoria Park, London, N.E.

See also page 287.

Hermite Electro-Chemical Bleaching Company, Limited, Electro-Bleachers, 3, Princes-mansions, Victoria-st, London, S.W.

Herron, G. F., Electrician, 14, De Vere-gardens, Kensington, London, W.

Hersey Brothers, Limited, Electric Light Engineers and Contractors, 70, Berners-st, Oxford-st, London, W.

Hervé, L., Manufacturers of Screws, Terminals, &c., 90, Clerkenwell-rd, London, E.C. (*Interchangeable London*)

Herzog, Conrad, C.E., Consulting Engineer, 37, Walbrook, London, E.C.

Hesketh, John, Electrical Engineer to the Corporation, West Caroline-st., Blackpool, Lancs.

Hesse, Frederick E., Secretary of the Eastern Extension, Australasia and China Telegraph Company, Limited, Winchester House, Old Broad-st, London, E.C. (*1107*)

Hett, Chas. Louis., Hydraulic Engineer and Turbine Manufacturer, Turbine Foundry, Brigg. (*L. Hett Engineer Brigg*).

Builder of the Galway Turbines, which is the largest application of Water Power to Electric Lighting in the United Kingdom.

Hewes & Geary, Electricians, Church Gresley, Swadlincote, near Burton-on-Trent

Hewett, John, B.A., A.I.E.E., Electrical Engineer, 14, Mill-st, Hanover-sq., London, W.

Hewett, J. H. C., Electrical Engineer, The Primrose Club, 4, Park-pl, St. James's, London, S.W.

Hewett & Oakes, Electrical Engineers, 14, Mill-st, Hanover-sq, London, W.

Hewitt, William, Electric Light Engineer, 74A, Chiswell-st, London, E.C.

Hewlett, Ernest F. J., M.I.E.E., Electrical Engineer to the Hove Commissioners, Town Hall, Hove, Sussex

Hexter, Humpherson & Co, Manufacturers of Stoneware Cable Conduits, Newton Abbot, Devon. (*Potteries Newton Abbot*)

Heydemann, Chas., Agent for Electrical Apparatus, 103, London-wall, London, E.C.

Heys, William E., Electrical Engineer, 70 Market-st, Manchester. (*Dynamics Manchester, 684*)

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Heywood, John, Publisher of Technical Books, Deansgate and Ridgefield, Manchester; 2, Amen-corner, Paternoster-row, London, and E.C., 33, Bridge-st, Bristol. (*Books Manchester, Nat. 553 and New 1082*)

Heywood, Joseph H., F.C.S., Electro-Chemist, 23, Holland-st, Rochdale, Lancs.

Heywood, S. H., Electrical Engineer, 12, Brazenose-st, Manchester

Hibberd, S., Electrician, 40, Southey-st, Bootle

Hibberdine, W., Traffic Accountant, the Eastern, the Eastern Extension, Australasia and China, the West African, and the Eastern and South African Telegraph Companies, Winchester House, London, E.C.

Hibbert, Charles, Electrical Engineer, Rushmore Lodge, Rushmore-rd, Clapton, London, N.E.

Hibbert, W., F.I.C., Teacher in Electricity, Polytechnic Institution, 309 and 311, Regent-st, W., and 14, Goldhurst-ter, South Hampstead, N.W., London

Hibbins, Wm. Geo., Electrician, Baxter Gate, Loughborough, Leicester

Hick, Hargreaves & Co, Limited, Electrical and General Engineers, Soho Iron Works, Bolton. (*Hick Bolton, 16*)

HICKS, JAMES J., Glass Blower for Electrical Purposes, &c., 8, 9, and 10, Hatton-gdn, London, E.C. (*Lenticular London.*) **See Advt., p. 35**

*Hicks, William Mitchinson, ScD., F R.S., Professor of Physics, Firth College, Sheffield

Higginbottom & Mannock, Makers of Electric Cranes, Crown Ironworks, West Gorton, Manchester. (*Crown Gortonbrook, 1577*)

Higgins, F., M.I.E.E., Telegraph Engineer, Exchange Telegraph Company, 17, Cornhill, London, E.C.

Highton, E. G., Engineer and Electrician, Eagle Foundry, Graham-st, City-rd, London, N.

Hildick & Hildick, Iron Telegraph Pole Manufacturers, &c., Walsall Tube Works, Pleck-rd, Walsall. (*Hildick Walsall*)

Hill, A. D., Electrical Engineer, 63, Ashley-gdns, Victoria-st, London, S.W.

Hill, A. W., Electrician, Edison-Swan United Electric Light Company, Limited, Ponder's End, Middlesex

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Hill, Chas. Henry, Electrical Engineer, Waverley Lodge, Lower Richmond-rd, Putney, London, S.W.

Hill, Claude W., Civil and Electrical Engineer, Manager to Messrs. Paterson & Cooper, European Works, Pownall-rd, Dalston, N.E., and "Eversleigh," Claremont-rd, Highgate, N., London. (*Hill c/o Platella London, 1140*)

Hill, Frederick A. (Representative of the Mannheim India Rubber, Gutta Percha and Asbestos Works Company), 108, Bishopsgate-street Within, London, E.C. (*Blasting London*)

Hill (Henry) & Sons, India Rubber and Sealing Wax Manufacturers, 38, Bow-lane, and 19, Garlick-hill, London, E.C.

Hill, H. Walker, C.E., Consulting and Mechanical Engineer and Patent Agent, 47, Hampden-st, Nottingham

Hill (Isaac) & Son, Makers of Malleable Iron Castings, St. George's Engineering Works, Wood-lane, Derby. (*Hill Derby, 227*)

Hill, James France, Electric Bell Fitter, 13 and 14, Great Newport-st, Charing Cross-rd, London, W.C.

Hill, Joseph Tripp, A.I.E.E., Assistant Controller, Central Telegraph Office, St. Martin's-le-Grand, London, E.C.

Hill (Richard) & Co., Limited, Iron and Steel Wire Drawers, Middlesborough; and 10, Eastcheap, London, E.C. (*Hills Middlesborough, 5081*)

Hill & Smith, Galvanised Iron Manufacturers, Brierley-hill, Staffs.; 113, Queen Victoria-st, London, E.C.; and at Glasgow and Dublin. (*Hill Brierley Hill; Fencing London*)

Hill (Thomas) & Co, Consulting Electrical Engineers, 12 to 30, Spoutmouth, Glasgow. (*Specify Glasgow, 4758*)

Hill, T. C., M.I.E.E., Electrician, 84, Hereford-rd, Bayswater, London, W.

Hill, —, Manganese Merchant, 27, Radnor-rd, Cardiff-rd

Hill-Hartland, W. H., Electrician, 723, Grimesthorpe-rd, Sheffield

Hillard, Geo., Electrician, 47, Forest-lane, Stratford, London, E.

Hille India Rubber Company, Limited, India Rubber Manufacturers, 43, Threadneedle-st, London, E.C.; and (Works) Eccles

Hillman, N. B., Electrical Agent, 28, Falcon-sq, London, E.C.

Hills (F. C.) & Co, Chemical Manufacturers, Chemical Works, Deptford, S.E.; and 17, Philpot-lane, London, E.C. (*Azote London*)

Hilton (F.) & Co, Belting Manufacturers, Castleton, near Manchester

Hind & Lund, Limited, Electrical Engineers, Metal Workers, and Tool Makers, Edward-st, Preston, Lancs.

Hindle, J. H., Telephone Engineer and Contractor, East-st, Bury, Lancs.

HINDLEY, E. S., Steam Engine Maker, 11, Queen Victoria-st, London, E.C.; and Bourton, Dorset. (*Steamport London, 1904; Hindley Bourton*) **See Advts., p. 553, &c.**

Hine, J. J., Electric Light and Telephone Engineer, Thorpe, Chertsey. (*Hine Thorpe Chertsey*)

Hinks (James) & Son, Limited, Lamp Manufacturers, 91-96, Great Hampton-st, Birmingham; and 148, Charing Cross-rd, London, W.C.

Hinshelwood (Thomas) & Co, Manufacturing Chemists, Oil Merchants and Refiners, Glenpark-st, Glasgow; and 86, Leadenhall-st, London, E.C. (*Taxin Glasgow, 886 and 4181*)

Hinson & Co, Limited, Fitters of Electric and Pneumatic Bells, 69, 71 and 73, Argyll-st, and Hinson-st, Birkenhead. (*Hinson Birkenhead, 4038*)

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Hinton, W. G., Telegraph Engineer, Postal Telegraphs, Moorgate-st-bldgs, Moorgate-st, London, E.C.

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Hirst & Co, Limited, Mechanical and Electrical Engineers, Croydon, Surrey

Hirst, Hugo, Electrical Engineer, General Electric Company, Limited, 71, Queen Victoria-st, London, E.C.

Hitchcock, W. M., Electrician, Westbank, Alton, Hants.

Hobart Electric Tramway Company, Limited, College Hill-chambers, Cannon-st, London, E.C.

Sir Benjamin Baker, K.C.M.G. { Consulting Engineer.
W. R. Harrower, C.A. ... .. Secretary.
See also page 287.

Hockley, N. J., Electrical Engineer, Brighton Corporation Electricity Works, North-rd, Brighton; and The Cottage, Seaton, Devon

Hodd (R.) & Son, Electro-Platers, Minerva Works, 30 and 31, Hatton-gdn, London, E.C. (*Candelabra London, 6623*)

Hodge & Co, Makers of Electric Light Fittings, 100 and 101, Hatton-gdn, and Robin Hood-yard, Leather-lane, London, E.C.; and College Works, Summer Hill, Birmingham

HODGES & TODD, Electrical Engineers and Manufacturers of Electrical Apparatus
HODGES, H. C., A.I.E.E.,
HODGES, P. W. O., A.M.I.C.E., } 82, Turnmill street, London, E.C.

Hodges, J. Percy, Electrician, 10, Cholmley-villas, Long Ditton, Surrey

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Hodgson (Frederick) & Co, Electrical Engineers, 56, Gresham-street, London, E.C.

Hodgson, G., Consulting Engineer, Tofts Mill, Whitcliffe, Cleckheaton

Hoeltzer, C., Telegraph Engineer, Cambridge House, Old Charlton, Kent

Hoerter, O. H., c/o Hanover Caoutchouc, Gutta Percha and Telegraph Works, 57, Basinghall-st, London, E.C.

Hoffert, Hermann H., D.Sc., Assoc. R.S.M., Inspector of Schools under the Science and Art Department, S. Kensington, London, S.W.

Hogg, H. E., Electrical Engineer, 80, Coleman-st, London, E.C.

Holborow & Co, Steam Engine Makers for Electric Lighting, Dudridge Ironworks, Stroud; and 16, Union-court, Old Broad-st, London, E.C. (*Holborow Cainscross*)

Holbrow, C. A., Electrical Engineer, Central Electric Light Station, Manchester-sq, London, W.

Holcroft (Thomas) & Sons, Limited, Manufacturers of Castings for Electrical and General Engineers, Ettingshall, Staffs.

Holden & Brooke, Limited, General Engineers, St. Simon's Works, Salford. (*Influx Salford*)

Holden, E. J., Electric Bell Fitter, 61, Sandgate-rd, Folkestone

Holden, Major H. Capel L., R.A., The Eaves, Belvedere, Kent

Holdom (S.) and Co, Electrical Engineers and Contractors, 2, Great Russell-st, London, W.C.

Holdsworth, J. G., Telegraph Engineer, Post Office Telegraphs, Newcastle-on-Tyne

Holgate, Thomas, Engineer and Manager, Corporation Gas Works, Halifax. (*Gasworks Halifax, 219*)

Hollander, C., Consulting Engineer, 12 Grosvenor-ter, York. (*Hollander York*)

Hollick, W. D., Electrician, 602, Commercial-rd, London, E.

Hollingsworth, H. C., Electrical Engineer, Electric Light Department, G.W. Railway, 150, Westbourne-terrace, Paddington, London, W.

Hollins, F. Thos, Telegraph Engineer, Great Eastern Railway Company, Liverpool-st, London, E.C.

Hollis, W., Electrician, 308, Wick-road, Victoria Park, London, E.

Hollom, John B., Consulting Engineer, 36, Gracechurch-st, London, E.C.

Holloway & Co. (Agents for Wm. Rickard, Insulated Wire Maker, Derby), 92, Watling-st, London, E.C.

Holloway Electricity Supply Company, Limited, 34, Victoria-st, London, S.W.
See also page 288.

Holloway, F. E., Insulated Wire Manufacturer and Coverer, 35, Summerfield-crescent, Birmingham

Holman, Stephen, M.I.C.E., Civil and Mechanical Engineer, 15, Great George-st, London, S.W.

*Holmes, Arthur Bromley, Electrical Engineer, 36, Princes-avenue, and 15, Highfield-st, Liverpool. (*Holmes c/o Dynamo Liverpool, 946*)

Holmes, Ernest, Electrician, Messrs. Siemens Bros & Co, Limited, Woolwich

Holmes, J. H., A.M.I.C.E., M.I.E.E., Electrical Engineer, Wellburn, Jesmond-rd, Newcastle-on-Tyne

HOLMES (J. H.) & CO, Electric Light and Power Engineers, Portland-rd, Newcastle-on-Tyne; 17, Coleman-st, London, E.C.; Oriel-chbrs, Water-st, Liverpool; and 27, Bothwell-st, Glasgow. (*Holmes Newcastle-on-Tyne; Vermilionette London; Current Liverpool; Efficiency Glasgow*)

Holmes, J. R., Telegraph and Electric Light Engineer, 41, Ann-st, Glasgow.

Holmes, L. W., Electrical Engineer, J. H. Holmes & Co., 17, Coleman-st, London, E.C. (*Vermilionette London*)

Holmes, Philip, Electrical Engineer, 154, Camberwell-grove, London, S.E.

Holmes & Sons, Limited, Engineers, Electricians, &c., Prospect-pl Works, Castle Meadow, Norwich (*Holmes Engineers Norwich*)

Holmes, Theodore, Electrical Engineer, Jesmond-gdns, Newcastle-on-Tyne

Holmes (W.), Cartwright & Co., Engineers and Contractors, 80, Cannon-st, London, E.C. (*Ignitor London*)

Holt, H. E. Sherwin., Chairman and Managing Director, Messrs. Swinburne & Co, Limited, Grove Bank, Teddington

Holt, William, Electrician, 83, Snargate-st, Dover

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Holt, Robert, M.I.M.E., Professor of Engineering, People's Palace, Mile End-rd, London, E.

Holtzapffel & Co, Mathematical Instrument Makers, Ivory Turners, &c., 64, Charing-cross, London, S.W., and 127, Long-acre, London, W.C.

Homacoustic Speaking Tube Company, Makers of the Homacoustic Commutator with Electric Signalling Device, 22, Queen-st, London, E.C. (*Scheschal London*)

HOME OFFICE, Whitehall, London, S.W. (*For Officials, see page 230.*)

HOME TELEPHONE COMPANY, Limited, Manufacturers of and Dealers in Telegraph, Telephone and Electric Light Apparatus, &c, 85, Queen Victoria-st, London, E.C. (*Doubling London, 150.30.*) **See Advt., p. 632**

See also page 288.

Hood, Joseph, Dealer in Engineers' Tools and Electrical Supplies, 9, Livery-st, and 2-16, Barwick-st, Birmingham. (*Hood Birmingham, 277*)

Hooke, David B., India Rubber Manufacturer, 155, Upper Thames-st, London, E.C.

Hooker, George S., Electrical Engineer, 184, Evering-rd, Clapton, London, N.E.

Hooker, Peter, Engineer, Pear Tree-ct, Farringdon-rd, London, E.C.

Hookey, J., Assistant Engineer-in-Chief, General Post Office, London, E.C.

Hookham, George, M.A., Electrical Engineer, Messrs. Chamberlain & Hookham, Limited 4, New Bartholomew-st, Birmingham

Hooper, Harry, Consulting Engineer, Billiter-sq-bldgs, Billiter-sq, London, E.C.

Hooper, J. P., Telegraph Engineer, Coventry-pk, Streatham, London, S.W.

Hooper's Telegraph and India Rubber Works, 31, Lombard-st, London, E.C. Works: Millwall Docks, London, E. (John P. Hooper, Manager)

Hooydonk, F. Van, Manufacturing Electrician, 750, Holloway-rd, London, N.

Hope-Bridie, R., Consulting and Inspecting Engineer and Electrician, 8, St. Benet-pl, London, E.C. (*Echecling London*)

Hope-Jones Electric Organ Company, Limited, 4, Huggin-lane, Queen Victoria-st, London, E.C.; and (Works) 55 and 57, Argyle-st, Birkenhead. (F. B. Townend, Secretary.) (*Autumn London; Hope-Jones Birkenhead, 4200*)

See also page 288.

Hope-Jones, Robert, M.I.E.E., Consulting Electrician and Engineer, 55 and 57, Argyle-st, Birkenhead. (*Hope-Jones Birkenhead, 4200* and *4033*)

Hopkin & Williams, Manufacturers of Acids and Chemicals, 16, Cross-st, Hatton-garden, London, E.C.

Hopkinson, Charles, M.I.C.E., Consulting Electrical Engineer, Princess-st, Manchester

*Hopkinson, Dr. Edward, Salford Iron Works, Manchester (*Hopkinson c/o Mather Manchester, 556*)

*Hopkinson, Dr. John, M.A., F.R.S., Consulting Electrical Engineer, 5, Victoria-st, London, S.W. (President of the Northern Society of Electrical Engineers.) (*3092*)

Hopwood, James, Electrician, 11A, Cargil-rd, Earlsfield, London, S.W.

Horn & Son, Patent Agents, 151, Strand London, W.C. (*Decision London*)

Horn, T. L., Electrician, c/o Messrs. Siemens Bros. & Co, Limited, Woolwich

Horne & Thornthwaite, Electrical Apparatus Manufacturers, 416, Strand, London, W.C.

Hornidge, Edward, Electrical Engineer, 423, Kingsland-rd, London, N.E.

Hornsby (R.) & Sons, Limited, Steam Engine Makers, Spittlegate Iron Works, Grantham, and 84, Lombard-st, London, E.C. (*Hornsbys Grantham; Hornsbys London*)

Hornsey, Wm., Ships' Telegraph Manufacturer, 17, Bernard-st, Southampton

Horrocks, Joseph, Electrician, 10, Union-st, Southport.

Horrocks, Peter, M.D., Medical Electrician to Guy's Hospital, 26, St. Thomas's-st, London, S.E.

Horseley Company, Limited, Mechanical and General Engineers and Ironfounders, Tipton, Staffs. (*Horseley Tipton*)

Horsfield, J. & J., Engineers, Boiler Makers, and Ironfounders, Dewsbury. (*Vulcan, Dewsbury, 114*)

Horton & Son, Limited, Mechanical and Electrical Engineers, Manufacturers of Tools, Nuts, Bolts, &c, Darlaston, Staffs; and 110, Cannon-st, London, E.C.

Horton, Wm., Engineer, Iron and Brass Founder, Swan Iron Works, Watford

Hosea, Tugby & Co, Manufacturers of Stoneware and Porcelain Electrical Apparatus, Moira, Ashby-de-la-Zouch, Leicestershire

Houghton (G.) & Son, Makers of Glass Globes, &c., 39, High Holborn, London, W.C.

*Houghton, J. E., M.I.E.E., Telegraph Engineer, London, Brighton, and South Coast Railway, London Bridge, S.E.

Houlder (W.), Son and Co, Sulphuric Acid Makers, Norwood Chemical Works, Southall, Middlesex; and 9, Mincing-lane, London, E.C. (*Houlder Southall*)

HOURS OF LIGHTING TABLES AND INFORMATION—see page *181*, and *The Electrician*, January 12, 1894.

House-to-House Electric Light Supply Company, Limited, Richmond-rd, West Brompton, London, S.W. (*Transformer London, 8653*)

H. R. Beeton ... ... Chairman
R. Hammond ... ... Managing Director
W. Coupland Weir ... Secretary

See also page 288.

Housman, Robert Holden, Electrician, 61, Marloes-rd, Kensington, London, W.

Hove Electric Lighting Company, Limited, Mansion House-bldgs, London, E.C.; and 79, Western-rd, Hove

Francis R. Reeves... ... Secretary
T. L. Reed Cooper ... Local Secretary

See also page 288.

Höveler & Dieckhaus, Metal Manufacturers, 3, Stockwell-avenue, London, S.W. (*Analyzing London*) (*See also* CONTINENTAL DIVISION.)

Howard, A. H., Electrical Engineer, 60, Broadhurst-gdns, London, N.W.

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Howard, B. F., Scotch Branch of Woodhouse and Rawson United, Limited, 12 Campbell-st, Glasgow (*Insulator Glasgow, 3717*)

Howard, F. Geere, Electrical Engineer, 10, Berners-st, London, W.; and 9, Gayton-rd, Harrow. (*Diagometer London*)

Howard, Dr. James L., Consulting Electrician (Demonstrator of Physics, University College, Liverpool), 20, Oxford-rd, Waterloo, Liverpool

Howarth, J. R., Maker of the "Emery" Primary Battery and other Electric Novelties, 243, Pentonville-rd, King's Cross, London, N.

Howe, William, Electrician, 87, Clarence-rd, New Cut, Bristol

Howell, E. James, Electrical Engineer, c/o Messrs. B. Verity and Sons, 43, Willow-rd, Birmingham

Howell, T. J., Electrical Engineer, 74, Buttesland-st, East-rd, Hoxton, N.

*HOWELL, J. C., Electric Light Engineer, 24, Queen Victoria-st, London, E.C.; and at New Dock, Llanelly. (*Jickajog London, 1942; Electric Llanelly, 312*)

Howell, J. C., Limited, Electrical Engineers and Contractors, 24, Queen Victoria-st, London, E.C.; and Llanelly, South Wales (*Jickajog London, 1942; Electric Llanelly, 312*)

See also page 289.

Howell, W. W., Representative in England of the Compagnie Française du Télégraphe de Paris à New York, 24, Royal Exchange, London, E.C. (*Telepany London*)

Howells, —, Electrical Engineer, Pontypool Electric Light and Power Company, Limited, Club-chambers, Pontypool, Mon.

Howes, A. J., Electrician, 73, St. Stephen's-rd, Upton Park, London, E.

HOWES, SIMEON, Sole Agent for the Little Giant Double Turbine, 64, Mark-lane, London, E.C. (*Barbeau London*) **See Advt., p. 639**

Horizontal type, specially applicable for Electric Lighting. Champion Water Motor, &c.

Howorth (James) & Co, Ventilator and Air Propeller Manufacturers, Victoria Works, Farnworth, near Bolton; and 46, Queen Victoria-st, London, E.C.

Hubber & Son, Electrical Engineers, 85 and 86, South-st, Exeter; and at Exmouth

Hucklesby & West, Electrical and Mechanical Engineers, 72, George-st, Luton.

HUDDLESTON, PERCY, Electrical Auctioneer and Valuer, 21, Upham-park-rd, Chiswick, London, W.; and at Manchester

Hudson, Albert George, Glass Bender, 46, St. George-st, London, E.

Hudson & Kearns, Tracing Paper Makers, &c., 83, Southwark-st, London, S.E. (*Hudson London, 4600*)

Hudson & Son, Electrical Instrument Makers, 15, and 16, Stockwell-st, Greenwich, London, S.E.

Hudson, W. H. H., M.A. (Prof. of Mathematics in King's College, London), 15, Altenburg-gdns, Clapham Common, London, S.W.

Hudswell, Clarke & Co, Engineers, Makers of "Rodger's" Pulleys, &c., Railway Foundry, Hunslet, Leeds (*Loco Leeds*)

Hughes, Chemery & Co, Metal Merchants, 118, Bishopsgate-st Wn, London, E.C. (*Brabant London*)

Hughes (George) & Sons, Drop Stamping and Iron Forging Manufacturers, Temple Works, Temple-st, Wolverhampton. (*Hughes Wolverhampton*)

Hughes & Gotto, Electrical Hydraulic and Mechanical Engineers 8, Highgate-rd, London N.W. (*Cubitum London*)

Hughes (Henry) & Son, Mathematical Instrument Makers, 59, Fenchurch-st, London, E.C.

Hughes & Lancaster, Electrical Engineers, City-rd, Chester; 47, Victoria-st, London, S.W.; and at Liverpool (*Lancaster Chester; Diagram Liverpool*)

Hughes, Josiah, Electric Bell Fitter, 237, High-st, Bangor

*Hughes, Prof. D. E., F.R.S., 40, Langham-st, Portland-pl, London, W.

Hughes, R. S., Limited, Electric Light Fittings Makers, 96, Hatton-gdn, and 4, Robin Hood-yd, Leather-lane, London, E.C. (D. J. Sadler, Secretary.) (*Chandelier London, 6677*)

Hughes, Son & Co, Solicitors of Patents, 38, Chancery-lane, London, W.C.

Hughes (T. Vaughan) & Co, Electrical Engineers, Greenfield, Holywell, Flintshire. (*Vaughan Hughes Holywell*)

Hughes, W. C., Scientific and Electrical Apparatus Maker, Brewster House, Mortimer-rd, London, N.

Hughes (William), Limited, Wire Drawers, 37, Drury-lane, London, W.C.

Hulett (D.) & Co, Limited, Mechanical and Electrical Engineers, 55 and 56, High Holborn, Hands-court, and Harper-mews, London, W.C. (*Hulett London, 2836*)

See also page 288.

Human, H., Surveyor, Guardian Fire Office, 11, Lombard-st, London, E.C.

Humber Lamp Company, Limited, Manufacturers of and Dealers in Electric Lamps, Great Grimsby

Humble, George, Electrical Engineer, 22, Fawcett-rd, Sunderland

Humble, Stephen, Mining and General Engineer, 9, Victoria-st, London, S.W.

Hume, G. H., Electrician, The Woodlands, Maryon-rd, Charlton, Kent

Humphrey, H. A., Electrician, Engineering Manager Brunner, Mond & Co, Ltd, Northwich, Cheshire

Humphreys, H. and W., Manufacturers of Electrical Apparatus, 37, Blackfriars-st, Manchester

Humphreys, J. C., Limited, Electric Light Engineers and Contractors, Knightsbridge, Hyde Park, London, S.W.

Humphreys, T., Electrical Engineer, Bright Brothers' Mill, Fieldhouse Mills, Rochdale.

Humpidge and Snoxell, Ltd. Makers of the "Dudbridge" Gas Engine, Stroud, Gloucestershire (*Humpidge Cainscross Stroud*)

Hunns & Co., Electrical Engineers, 20, Stopford-rd, Plaistow, London, E.

Hunt, A. Marshall, Electrical and Mechanical Engineer, 14, Prince-st, Bristol

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Hunt (J.) & Co., Makers of Electric Light Fittings, Sampson-rd North, Birmingham; and 58, Holborn-viaduct, London, E.C. (*Sampson Birmingham*)

Hunt & Mitton, Brass and Copper Founders and Manufacturers, Ozells-st North, Birmingham (*Mitton Birmingham*)

Hunter, Chas. L., Electrical Engineer, Central Electric Light Station, Bute Docks, Cardiff

Hunter, David, Electrical Engineer, Lanark

Hunter & Oliver, Electrical Engineers, 67, Tottenham Court-rd, London, W.

Hunter, W. D., Electrical Engineer, Newcastle and District Electric Lighting Company, Limited, 38, Grainger-st West, Newcastle-on-Tyne

Hurley, E. B., Electrician, Royal Colonial Institute, Northumberland-avenue, London, S.W.

Hurrell, M. E., Managing Director, Chatham, Rochester and District Electric Lighting Company, Limited, Fair View, New Brompton, Kent

Hurry & Young, Electrical Engineers, 16, Princes-st, Edinburgh

Hurst (A.) & Co, Makers of Accumulators and Appliances for Medical Purposes, 6, Fowkes-bldgs, Great Tower-st, London, E.C. (*Virifico London*)

Hurst, G., Practical Engineer and Model Maker, 257, High Holborn, London, W.C.

Hurst, Geo. H., F.C.S., Analytical and Consulting Chemist, Laboratory, 22, Blackfriars-st, Manchester

Hurtzig, Arthur Cameron, Civil Engineer, 2, Queen-sq-pl, London, S.W.

Hutchings, Arthur, Electrician, 88, Copleston-rd, Peckham, London, S.E.

Hutchins, Clarence D'Oyley, Electrical Engineer, Holly-grove, Feltham Hill, Middlesex

Hutchinson Bros, Electrical Engineers, Falcon Works, Sackville-st, Barnsley. (*Hutchinson Brothers Barnsley*)

Hutchinson, Richard R., Electrical Engineer Pear Tree House, Fulham-rd, South Kensington, London, S.W.

Hutchinson, W. B., C.E., F.R.A.S., Consulting Engineer, The Observatory, Liversedge, Yorkshire (*Hutchinsons Liversedge*)

Hutchinson, W. E., Electric Light Engineer and Bell Fitter, 263, Hampstead-rd, London, N.W.

Hyde, George T., Registered Patent Agent and Electrician, 4, Moorfields, Fore-st, London, E.C.

Hyde, John Derby, Electrician, Bloxham, Banbury, Oxon.

Hydes & Wigfull, Engineers and Iron Workers, Stanley-st, Wicker, Sheffield. (*Hydes and Wigfull Sheffield, 1123*)

Hydrogen Amalgam Company, Limited, 23, Cross-st, Finsbury, London, E.C. (T. Donald Watson, Secretary)

Hyland, C., Electrican, 51, Macfarlane-rd, Shepherd's Bush, London, W.

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Iago, Frank, F.I.S., Secretary Westminster Electric Supply Corporation, Ltd, Eccleston-pl, Belgravia, London, S.W. (*3271*)

I'Anson, James, Dealer in Electric and Hydraulic Plant, Darlington

Ibbotson Bros & Co, Steel Manufacturers, Globe Steel Works, Sheffield; and at Liverpool and London. (*Ibbotson Sheffield*)

Icke (Thomas) & Son, Belting Manufacturers, &c., Heath Leather Works, West Bromwich (*Leather West Bromwich*)

Iddon Brothers, Makers of Electric Wire and Cable-Covering Machines, Brookfield Iron Works, Leyland, near Preston

IDE, T. & W., Makers of every description of Glass Globes, &c., for Electric Lighting, Glasshouse-fields, Ratcliff, London, E. (*Twicle London, 5133.*) **See Advt., p. 570**

Iles, C. H., Electrical Engineer, 38, Larches-lane, Wolverhampton

Illingworth, Ingham & Co, Makers of Wire Casings, &c., Patent Wood Cutting Mills, Leeds; and Great Guildford-st, London, S.E. (*Timber Leeds; Illingworth London, 4933*)

Illustrated Official Journal (*Patents*) (weekly), 38, Cursitor-st, Chancery-lane, London, E.C. (Annual subscription £1. 6s., post free £1. 15s.; single copies 6d., post free 8d.)

Imhof & Mukle, Makers of Electric Organs and Pianos, 110, New Oxford-st, London, W.C.

Immisch, Moritz, Electrical Engineer, 48, Tollington Park, London, N. (*Amharic London*)

Imperial Continental Gas Association, 21, Austinfriars, London, E.C. (Robert S. Gardiner, Secretary.) (*Imperial Continental London, 1337.*) (*See also* CONTINENTAL DIVISION)

Imperial Enamel Company, Makers of Cones and Reflectors for Electric Light, Watery-lane, Birmingham. (*Impervious Birmingham*)

IMPORT DUTIES (Colonial and Foreign) on Electrical Machinery and Apparatus, &c. —*see pages 186 to 189*

Imray, Harold, Electrician, 28, Southampton-bldgs, London, W.C.; and The Grange, Underhill, New Barnet, Herts

Imray, John (Abel & Imray), Patent Agent, 28, Southampton-bldgs, Chancery-lane, London, W.C. (*2729*)

Imrie, John E. Wilson, Electrician, Holm-next-the-Sea, King's Lynn

Incandescent Electric Lamp Company, Limited, Incandescent Lamp Makers, 71, Queen Victoria-st, E.C., and Brook-green, Hammersmith, W., London. (C. J. Robertson, Engineer and Technical Director; A. C. Ganson, Secretary)

See also page 288.

Incorporated Society of Municipal and County Engineers. (President, J. T. Eayrs; Secretary, Thomas Cole, 11, Victoria-st, London, S.W.)

INDESTRUCTIBLE PAINT COMPANY, Ltd, Makers of Browning's Enamel Paint and Colourless Preservative Solution, 27, Cannon-st, and 42, Bread-st, London, E.C., and (Works) 77, Salmons-lane, Limehouse, E. (W. L. Pratt, Secretary)

INDIA OFFICE, St. James's park, London, S.W. (*For Officials, see p. 232*)

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India Rubber, Gutta Percha, and Telegraph Works Company, Limited 106, Cannon-st, E.C. (*Silvergray London, 1746*). Works: Silvertown, Essex (*Graysilver London*); and Persan Beaumont, France.
S. W. Silver ... ... Chairman
Matthew Gray ... ... Managing Director
R. Kaye Gray ... ... Engineer-in-Chief
W. J. Tyler ... ... Secretary
See also page 288.

India Rubber, Gutta Percha, and Electrical Trades' Journal (monthly), 28, Wilson-st., Finsbury, London, E.C. (Ann. sub., 15s.)

INDO-EUROPEAN TELEGRAPH COMPANY, Limited, 18, Old Broad-st, 11 and 12, Mincing-lane, and 6 and 8, Lime-st-sq., London, E.C.; Walmer-bldgs, 6, Water-st, Liverpool; and 60, Spring-gdns, Manchester. (*Indo London*) **See Advt., p. cxxxi.**
J. H. Tritton ... ... Chairman
W. Andrews ... ... Managing Director
F. Moll ... ... Secretary
See also page 288.

Industrial and Mercantile Investment Corporation, Limited, Dealers in Electrical Apparatus, 39, Victoria-st, London, S.W.
Capt. H. H. Grenfell, R.N. ... Chairman
Thomas Newton ... ... Secretary

Industries and Iron (weekly), 17 & 18, Henrietta-st, Strand, London, W.C. (Annual sub., £1; single copies, 6d.) (*Indus London, 35161*)

Ingersoll-Sergeant Drill Company of America, Makers of the Crescent Battery for Electric Blasting, 114A, Queen Victoria-st, London. (*Enyam London*). (*See also* AMERICAN DIVISION)

Ingham, W. P., Engineer, and Manufacturer of the "Ingham" Gas Producer, Middlesborough

Inglis, Hugh, Electrical Engineer, Frodingham, nr Doncaster (*Inglis Scunthorpe*)

Ingram, Arthur, Electric Bell Manufacturer, 5, Clerkenwell-rd, London, E.C.

Ingram (J. G.) & Son, India Rubber Manufacturers, The London India Rubber Works, Hackney Wick, London, E. (*Ingrams London, 5089*)

Ingram & Kemp, Electric Light Fittings Manufacturers, Newtown-row, Birmingham (*Gaslight Birmingham, 471*)

Ingrey, Charles, Consulting Engineer, 60, Watling-st, London, E.C.

INSTALLATION REGULATIONS OF LONDON SUPPLY COMPANIES—*see pp. 150 to 158*

Institute of Chemical Technology and Analytical Laboratory, 5-11, Hackin's Hey, Dale-st, Liverpool. (*Norman Tate Liverpool, 235*)

Institute of Chemistry of Great Britain and Ireland, 30, Bloomsbury-sq, London W.C. (G. H. Robertson, F.C.S., A.I.C., Registrar and Secretary)

Institute of Scientific Research, 67, Broad-st, Birmingham

Institution of Civil Engineers, The, 25, Great George-st, London, S.W. (*Institution London, 3051*)
Alfred Giles ... ... President
James Forrest ... ... Secretary

Institution of Civil Engineers of Ireland, 35, Dawson-st, Dublin
John C. Smith, M.I.C.E. ... ... President
Henry A. Ivatt, M.I.C.E. ... ... Secretary

INSTITUTION OF ELECTRICAL ENGINEERS, 28, Victoria-st, London, S.W. (*3153*) (*For Objects, List of Council and Officers, and other information, see pages 257 to 262*

Institution of Engineers and Shipbuilders in Scotland, 207, Bath-st., Glasgow
John Inglis ... President
W. J. Millar ... Secretary, and Editor of *Transactions*

Institution of Mechanical Engineers, The, 19, Victoria-st, London, S.W. (*Mech London, 3264*)
Dr. W. Anderson, F.R.S. ... President
Alfred Bache ... ... Secretary

International Aluminium Company, Aluminium Manufacturers, 98, Regent-st, London, W.

International Electric Company, 55, Red Cross-st, Barbican, London, E.C. (H. Oppenheimer, Manager) (*Genest London*)

INTERNATIONAL ELECTRIC SUBWAY COMPANY, Limited, 39, Victoria-st., S.W., (*3262*), and 12, King William-st, E.C. (*1445*), London. (Mortimer R. Margesson, Manager) (*Evolve London*) **See Advt., p. 463**
Conduits (Cast Iron) for Electric Light and Power, Telegraph and Telephone Cables
See also page 288.

International Electric Syndicate, Limited—*in liquidation.* (C. J. Stewart, Official Receiver, 33, Carey-st, London, W.C., Liquidator)

International Oil Company, Lubricant Manufacturers, 61 and 62, Gracechurch-st, London, E.C. (*Falene London, 1081*)

International Okonite Company, Limited—*now* Okonite Company, Limited (*q.v.*)

Invention (weekly), 54, Fleet-st, London, E.C. (Price 2d.) (*Negotiate London, 2669*)

Inventors' Institute, 27, Chancery-lane, London, W.C. (S. J. Mackie, C.E., Hon. Secretary)

Inventions Contract Syndicate, Limited, General Engineers, 17, Greek-st, Soho, London, W.

Inventors' Exploitation and Development Company, Limited, Patent Experts, 46, Queen Victoria-st, London, E.C.

Inventors' Patent Right Association, Limited, Patent Agents, 2, Lancaster-place, London, W.C. (A. Myall, Manager.) (*Ipra London*)

Ipswich Electricity Supply Company, Limited, Acme and Immisch Electric Works, Ferdinand-st, Chalk Farm, London, N.W.

Ireland, A. J., Electrical Engineer, 13, Minch-avenue, Harlesden, London, N.W.

Ireland, T., Telegraph Engineer, Great Northern Railway Company, Retford

Iron and Coal Trades' Review, with which is incorporated the *Bulletin of the British Iron Trade Association* (weekly), Outer Temple, 222-5, Strand, London, W.C. (Price 6d.)

Iron and Steel Institute, 28, Victoria-st, London, S.W.
E. Windsor Richards, M.I.C.E. President
Bennett H. Brough ... ... Secretary

Iron and Steel Trades Journal and Mining Engineer (weekly), 84, Cannon-st, London E.C. (*Cerebellum London*) (Price 6d.)

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Ironmongers' Chronicle (monthly), 139 and 140, Fleet-st, London, E.C. (Ann. sub., 5s.)

Ironmonger, Universal Engineer, and Metal Trades Advertiser (weekly), 42, Cannon-st, London, E.C. (Price 6d.) (*Ironmonger London, 1852*)

Ironmongery (monthly), 148 and 149, Aldersgate-st, London, E.C. (Price 3d.)

Iron Wire, Wire Rope and Fencing Company, Wire Manufacturers, 5, Victoria-st, London, S.W. (*Rowell London*)

Irvin & Sellers, Turners of Coils, Lampholders, Pushes, &c, Peel Hall Works, Preston (*Primus Preston*); and at London, Liverpool, &c.

Irvine, A. H., M.I.C.E., 180, Stockport-rd, Levenshulme, Manchester

Irvine, H. A., Electrical Engineer, c/o Albright & Wilson, Limited, Oldbury, Wolverhampton

Irvine, James M., Electrical Engineer, Fairfield-rd, Inverness

Irwell Rubber Company, Dynamo Belting Manufacturers, 41, St. Mary-axe, London, E.C.; and Salford, Manchester

Isca Foundry Company, Engineers and Ironfounders, Manufacturers of Switches &c, Newport, Mon; and 10, Bush-lane, London, E.C. (*Isca Newport; Isca London*)

Isitt & Co, Electrical Engineers, 39, Victoria-st, London, S.W.

Isle of Wight Electric Lighting Company, Limited, 21, Lime-st, London, E.C. (F. R. Reeves, Secretary)

See also page 38.

Isler (C.) & Co, Artesian Well Engineers, Artesian Works, Bear-lane; and Edward-st, Southwark, London, S.E. (*Isler London*)

Isles, Limited, Engineers and Makers of Cranes, Lifts, &c., Stanningley, Leeds; and 11, Queen Victoria-st, London, E.C.

Ismay, J., Chief Superintendent, Postal Telegraphs, Liverpool

Ivey (Robert G.) & Co, Electrical Engineers, Cayton-st, City-rd, London, N.

Ivor-Moore, T., C.E., A.I.E.E., Electrician, Fairfield, Gold Tops, Newport, Mon.

Izant, Frederick, Electric Bell Maker, 50, Kenton-st, Brunswick-sq, W.C., and Headstone-rd, Harrow, W., London

— J —

Jackson, A. W., Electrical Engineer, 7, Thayer-st, Manchester-sq, London, W.C.

Jackson Bros, Dealers in Electrical Supplies, 153, Regent-st, Salford

Jackson Bros, Limited, Manufacturers of Drawing Materials, 50, Call-lane, Leeds. (*Technical Leeds, 681*)

Jackson (F.) & Co, Manufacturers of Scientific Apparatus, 10, Half Moon-st, Manchester. (*Apparatus Manchester*)

Jackson, F. H., Electrical Engineer, City of London Electric Lighting Company, Ltd, 1 and 2, Great Winchester-st, London, E.C.

Jackson, H. F., Electrical Engineer, 85, Queen Victoria-st, E.C., and 31, Harrington-gardens, S.W., London

Jackson, H. R., Superintending Telegraph Engineer Lancashire and Yorkshire Railway Company, Glenthorn, Horwich, near Bolton

Jackson, John, Electric Light Contractor, 3, Victoria-st, London, S.W.

Jackson (P. R.) & Co, Limited, Engineers and Ironfounders, Salford Rolling Mills, Hampson-st, Manchester. (*Jacksons Manchester, 635*)

Jackson, R. C., Electrician, Newcastle-on-Tyne Electric Supply Company, Limited, 1, St. Nicholas-bldgs, and 4, Framlington-pl, Newcastle-on-Tyne

*Jackson, Colonel R. Raynsford, Director of the National Telephone Company, Limited, Oxford-court, Cannon-st, E.C., and 31, Harrington-gdns, South Kensington, S.W. (*8711*), London

Jackson, W. H., Electrician and Electric Bell Manufacturer, Grantham

Jackson, —, Electrician, 38, Beaconsfield-rd, Brighton

Jacob, A., Electrician, 86, Colveston-crescent, Dalston, London, N.E.

Jacob, D. A., Dealer in Electrical Supplies, 80, Grosvenor-rd, London, N.

Jacob, F., Electrician, Ellesdene, Beaconsfield-rd, Westcombe Park, London, S.E.

Jacob & Schreppel, Agents for the Sale of Porcelain for Electrical Purposes, 28 and 29, London-wall, London, E.C. (*Schreppel London*)

Jacobs, Charles M., C.E., Consulting Engineer 88, Bishopsgate-st Within, London, E.C.

Jacques & Maguire, Electrical Engineers, 67, Harold-rd, Upton Park, London, E.

Jaffe, Max, India Rubber Manufacturer, 1, Crutched Friars, London, E.C.

James, Aubrey, Electrician, 29, Nightingale-st, Abercanaid, Merthyr Tydvil

James (C.) & Co, Manganese Merchants, 99, Fenchurch-st, London, E.C. (*Scmaj London*)

James, H., Manufacturer of Wire-Covering Machinery, 20 and 21, Windley's Factory, Roden-st, Nottingham

James, Henry J., Electrical Engineer and Contractor, 135, Cowick-st, St. Thomas, and 63, Bonhay-rd, Exeter. (*James Cowick-street Exeter*)

James (John) & Son, Iron and Chemical Merchants, 21, Lime-st, London, E.C. (*Quickly London, 2479*)

James, W., Electrician, 3, Gloucester-row, Richmond-rd, Kew, Surrey

*Jamieson, Prof. Andrew, M.Inst.C.E., F.R.S.E., Consulting Electrician and Professor of Electrical Engineering, Glasgow and West of Scotland Technical College, 38, Bath-st, Glasgow

Jamieson, W. & J., Platinum Dealers and Factors, 10, Broad-st, Golden-sq, London, W. (*Digital London*)

Jamieson, W. R., Electrician, c/o Wm. Cleghorn, jun., Clepington, Dundee. (*Jamieson c/o Horn Dundee*)

Japp, F. R., LL.D., F.R.S., Professor of Chemistry, The University, Aberdeen

Japy Bros. & Co., Electric Light Lamp Makers, 75, Queen Victoria-st, London, E.C. (*Changeable London*)

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Jardine, John, Pulley and Shafting Maker, Deering-st Works, Nottingham. (*Jardine Nottingham, 295*)

Jarman, A. J., Electrician and Electrical Engineer, 41, St. John's-hill, Clapham-junction, London, S.W.

Jaroslaw, D., Mica Merchant, 16, Water-lane, Great Tower-st, London, E.C. (*Monazite London*)

Jarratt, J. T., Maker of Lathes for Electricians, Queen-st, Leicester

Jasper, W., Electrician, Countess-pl, Nottingham

Jeakes (C.) & Co, Electrical Engineers, 51, Great Russell-st, London, W.C.

Jeans, J. S., Consulting Engineer and Editor of the *Engineering Review*, 29, Great George-st, London, S.W.

Jeckell, J. A., Borough Electrical Engineer, South Shields

Jeffery, S. F., Electrical Engineer, Royal Albert Music Hall, 6, Victoria Dock-rd, Canning Town, London, E.

Jeffrey, Wm., Electrical Engineer, 39, Beckton-rd, Barking-rd, London, E.

Jenkin, B. M., Electrician, 29, Whitehall-ct, London, S.W.

Jenkin, John, Superintending Engineer, Postal Telegraphs, Cambridge

Jenkins, Fred., Electrical Engineer, Wynyard Park, Stockton-on-Tees

Jenkins, R., Manufacturer of Electrical Stampings and Forgings, Magnet Forge, 88, Bishopsgate-st, London, E.C. (*Permeable London*)

Jenkins, T. A., Electrician, Heolgerring, Merthyr Tydvil

Jenkins, T. C., General Manager, City and South London Railway Co, Limited, 46, King William-st, London, E.C. (*Tunnelling London*)

Jenkins (W.) & Son, Lightning-Conductor Manufacturers, 36, Parade, Leamington

Jenkinson, B. Holmes, Electrical Engineer, c/o Messrs. Crompton & Co, Limited, Mansion House-bldgs, London, E.C.

Jennings, E. J., Electrical Engineer, Royal Insurance-bldgs, Newcastle-on-Tyne; and 759, Old Kent-rd, London, S.E.

Jennings, George, Maker of Electro-Mechanical Liquid Level-Indicating Apparatus, Lambeth Palace-rd, London, S.E. (*Jennings London, 4680*)

Jenrick & Crocker, Electric Light Contractors, 233, Borough High-st, London, S.E.

Jensen, H., Electrician, Flodden House, Theydon Bois, Essex

Jensen & Son, Patent and Registration Agents, 77, Chancery-lane, W.C. (*Venture London*)

Jessop & Son, Art Metal Workers, 19, Knowsley-rd, Battersea, London, S.W.

Jessop (J.) & Son, Crane Builders, London Steam Crane and Engine Works, Leicester. (*Jessop Leicester*)

Jessop (Wm.) & Sons, Limited, Engineers, Manufacturers of Steel Castings, &c., Brightside Works, Sheffield; and 76, Cannon-st, London, E.C. (*Jessops Sheffield*)

Jeyes, John, Electrician, 3, Excelsior-ter, Saunders-rd, Plumstead, Kent

Joel (H. F.) & Co, Electric Light Engineers and Contractors, City Electric Light Works, 31, Wilson-st, Finsbury, London, E.C.

Johannesburg Lighting Company, Limited, Electric Light and Gas Contractors, 6, Great Winchester-st, London, E.C. (*4481*)

See also page 389

Johns, C. W., Manufacturer and Designer of Art Metal Work, Electroliers, &c., 230, Upper-st, London, N.

Johnson Brothers, Limited, Manufacturers of Lubricants, Cleveland Works, Air-st, Hull; and 41, Eastcheap, London, E.C.

Johnson, Charles, Electrician, Middlegate and Boar-lane, Newark, Notts

Johnson, Charles, Mica and Talc Merchant, 140, Charing Cross-rd, London, W.C.

Johnson & Co, Electrical Engineers, High-st, Staines

Johnson, Edward, Consulting Engineer, 28, Victoria-st, London, S.W.

Johnson, G. W., Electrician, 109, Welsh-row, Nantwich, Cheshire

Johnson, Henry, Dealer in Electrical Supplies, 1, Custom House-arcade, Liverpool

Johnson, J. E., Engineer and Electric Light Contractor, Highcross-st, Leicester

Johnson (J. H.) & Co, Patent Agents, 47, Lincoln's Inn-fields, London, W.C. (*Lincijohn London, 2646*)

Johnson, J. H. & S., Chemical and Scientific Apparatus Makers, 6, 8, & 10, Whitechapel, Liverpool. (*Sodium Liverpool, 700*)

Johnson, J. Thewlis, Telegraph Wire Manufacturer, Bradford Iron Works, Manchester; and 8, Great Winchester-st, London, E.C. (*Johnsons Manchester; Resistance London*)

Johnson, Joseph, Electric Bell Fitter, 49, Halton-rd, Islington, London, N.

Johnson, Matthey & Co, Limited, Platinum Refiners, &c., Hatton-gdn, London, E.C. (*Matthey London, 6568*)

Johnson's Patents, Limited, Ironfounders, Mechanical and Electrical Engineers, Oak-st Works, West Gorton, Manchester. (*Premier Manchester*)

JOHNSON & PHILLIPS, Telegraph and Electric Light Engineers, Makers of all kinds of Electrical Plant and Apparatus, &c, 14, Union-court, Old Broad-st, London, E.C., and Victoria Works, Charlton, Kent. (*Juno London, 1010.*) **See Advt, p. 3**

Johnson (Richard), Clapham & Morris, Limited, Wire Drawers, 23, Cheapside, Dale-st, Liverpool: and Lever-st, Manchester (*Johnsons Liverpool, 539; Metallicus Manchester, 437*)

Johnson (Richard) & Nephew, Iron Masters and Wire Drawers, Galvanisers, and Telegraph Contractors, Bradford Iron Works, Manchester: Alderwasley, Ambergate, near Derby; and 8, Great Winchester-st, London, E.C. (*Johnsons Manchester, 437; Johnsons Ambergate; Resistance London, 337*)

Johnson & Sons, Manufacturing Chemists, Limited, Platinum Manufacturers and Refiners, 23, Cross-st, Finsbury, London, E.C. (*Caustic London*)

Johnson (T. B.) & Son, Wire Drawers, 23, Great Sutton-st, London, E.C.

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Johnson, Thos., Dealer in Electrical Apparatus, Prescott-st, Wigan. (*Johnson Wigan, 57*)

Johnson, Thos. T., Manufacturer of Microscopes and Small Electrical Goods, Optical Works, Catharine-st, Salisbury

*Johnson, W. Claude, M.Inst.C.E., M.I.E.E., The Dignaries, Westcombe Park, Blackheath, London, S.E. (*Jonadab London*)

Johnson (William) & Co., Electricians and Electrical Engineers, 196, Brookhill, Sheffield

Johnson, William, Engineer and Boiler Maker, Castleton Foundry, Armley-rd, Leeds. (*Ronksley Armley, 387*)

Johnson, William, Manager and Secretary, Sheffield Electric Light and Power Company, Commercial-st, Sheffield. (*Electricity Sheffield*)

Johnson, W., Scientific and Electrical Instrument Maker, 188, Tottenham Court-rd, London, W.

Johnson, W. H., Engineer and Electrician, Lynn

Johnston, Duncan W., Electrical Engineer, Faraday Electrical Company, Limited, Govan, Glasgow

Johnston (James) and Co, Electric Light Engineers, 4, Corporation-st, Manchester

Johnston, W. H., Electrician, 70, High-st, Southampton

Johnstone, Benjamin, & Co, Telegraph Wire Coverers, 3, Wenlock-rd, and 12A, Edward-st, City-rd, London, N.

Johnstone, James, Iron and Metal Agent, 51, St. Vincent-st, Glasgow. (*Rails Glasgow, 4203*)

Johnstone, Jas., Consulting Electrician, 8, Merchison-park, Edinburgh

Author of "The Ether Theory of Electricity," published in 1889, establishing by facts that there is only one Electricity, and that it passes through the glass of a Leyden jar by conduction, and not by the fallacy of induction. Price 2s., post free, from the Author.

Johnstone (W. H.) & Co, Electricians and Electrical Engineers, Howe Electrical Works, Irvine-st, Liverpool, E.

Johnstone, William, Analytical Chemist, Temple Laboratory, Effingham House, Arundel-st, Strand, London, W.C.

Jolin (P.) & Co, Scientific Instrument Makers, &c, 35, Narrow Wine-st, and Church-st, Bristol

Jonas & Colver, Limited, Manufacturers of Steel for Magnets, Continental Steel Works, Sheffield. (*Jonas Sheffield, 663*)

Jonas, John, Electric Light and Power Contractor, 38, Lime-st, London, E.C. (*Ekdum London, 4300*)

Jones, A. W., Electrical Engineer, Laing, Wharton & Down Construction Syndicate, Limited, 38, Parliament st, London, S.W.

Jones & Bradshaw, India Rubber Belting Manufacturers, 13A, Eastcheap, London, E.C.

Jones Bros., Makers of Slate Switch Bases, Bangor Wharf, 197A, Buckingham Palace-rd, London, S.W.

Jones Brothers & Co, Reflector and Shade Manufacturers, Ablow-st, Wolverhampton; and 17, Bishopsgate-avenue, Camomile-st, London, E.C. (*Jones Wolverhampton; Hands London*)

Jones, Burton & Co, General Engineers, 19, Castle-st, Liverpool. (*Enterprise London*)

Jones, C., M.Inst.C.E., Engineer to the Ealing Local Board, Public-bldgs, Ealing, Middlesex. (*Urbanissime London*)

Jones, Charles, Electrical Engineer, Gorsebrook House, Stafford-rd, Wolverhampton

Jones, C. E., Electrical Engineer, 1, Birch-st, Wolverhampton

Jones & Co, Dealers in Electrical and Scientific Apparatus, 302, Holloway-rd, London, N.

Jones, F. W. E., Electrical Engineer, Central Electric Light Station, Wise-st, Leamington

Jones, G. A., Electrician, 11, Parkhurst-rd, Holloway, London, N.

Jones, George, Limited, Mechanical and Electrical Engineers, Lionel-st, Birmingham

Jones, G. H., Electrical Engineer, 12, Addison-gdns, London, W.

Jones, Henry, Electrical Engineer, 14, High-st, Lambeth, London, S.E.

Jones, Herbert, Engineer, 69, Hope-st, Liverpool

Jones, Inigo, Slate Turner, &c, Tudor Slate Works, Groeslon, R.S.O., North Wales. (*Inigo Jones Penygroes*)

Jones (John) & Co, Engineers, Millwrights, &c., Brunton Works, Brunton pl, Commercial-rd, London, E.

Jones, Noel Crossly, Electrician, Campsie, Hill-lane, Southampton

*Jones, Prof. Viriamu, Professor of Physics, University College, Cardiff

Jones, Thos. Hill, Manufacturer of Chemicals of all descriptions for Electrical Purposes, 31 Eagle Wharf-rd, London, N.

Jones, W. A., Electrician, 69, King-st East, Rochdale.

Jones, Walter F., Electrical Engineer, Messrs. W. T. Goolden & Co, Woodfield Works, Harrow-rd, London, W.

Jones, William, Electrician, 7, Goldney-rd, Clifton, Bristol

Jones & Willis, Art Metal Workers, 43, Great Russell-st, and 33, Duke-st, Bloomsbury, London, W.C.

Jordan (Chas.) & Sons, Ltd, Makers of Dynamo Castings, Pilgwenlly, Newport, Mon.

Jordan (T. B.) & Son, Mining and Electrical Machinery Manufacturers, 15, George-st, Mansion House, London, E.C.; and Union Iron Works, Carnarvon. (*Arrastra London*)

Joseph, Davis & Co, Scientific Instrument Makers, 6, Kennington Park-rd, London, S.E. (*Equably London*)

Joseph, Edward L., Electrician, 92, Queen Victoria-st, London, E.C.

Joubert (Amedée) & Son, Electrical and Mechanical Engineers, 152, King's-rd, Chelsea, London, S.W.

Journal of Gas Lighting (weekly), 11, Bolt-ct, Fleet-st, London, E.C. (Price 6d.) (*Gasking London, 2759*)

Journal of the Society of Chemical Industry (monthly), Palace-chmbrs, 9, Bridge-st, Westminster, London, S.W. (Watson Smith, Editor) (Ann. sub., 30s.)

Jowett, —, Engineer and Electrician, Borough-rd, St. Helens

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Joy, David, Consulting Engineer, 17, Victoria-st, London, S.W. (*3075*)

*Joyce, Samuel, A.I.E.E., Instructor in Electrica, Engineering, Electro Metallurgy, Physics, &c. Manchester Technical School, Whitworth-st, Manchester; and 50, The Crescent, Salford

Joyner (Charles) & Co, Manufacturers of Electric Light Fittings, Icknield-sq, Monument-rd, Birmingham; and 59-61, Hatton-gdn, London, E.C. (*Joyner Birmingham*)

Jukes, Coulson, Stokes & Co, Telegraph Buoy Makers, 13, Clement's-lane, E.C., and St. Leonard's Works, Bromley-by-Bow, E., London; and at Sheffield. (*Kolson London*)

Junior Engineering Society, Westminster Palace Hotel, London, S.W.
John Wolfe Barry, M.I.C.E. ... President
Walter T. Dunn, 47, Fentiman-rd, London, S.W. } Secretary

Justice, P. M., Patents, Trade Marks and Designs Agent, 55 and 56, Chancery-lane, London, W.C. (*Syng London, 2504*)

— K —

Kahn, Henry, Mica Merchant, 131, Fenchurch-st, London, E.C.

Kamm, Leo, Electrical Engineer, 1, Gresley-rd, Highgate, London, N.

*Kapp, Gisbert, Consulting Electrical Engineer, 31, Parliament-st, London, S.W.

Kayser, Ellison & Co., Wire Drawers and Machine Tool Makers, Carlisle Works, Sheffield

Keay (E. C. and J.), Limited, Electrical, Mechanical and General Engineers, Cyclops Iron Works, West Bromwich; James Bridge Works, Darlaston, Staffs.; and at Manchester

Keay, Thomas C., Sole Importer of the Government Waterproof Belt Dressing, Baltic-st, Meadowside, Dundee. (*Keay Dundee, 322*)

Keays, Arthur M., Electrician, Wandle Cottage, Croft-rd, Sutton, Surrey

Keeling (Edgar), Teale & Co, Art Metal Workers, 14, Elm-street, Gray's Inn-road, London, W.C.

Keen, H. E., Electrical Engineer, New British Electric Installation Contractors, Limited, 21, Broad-st, Worcester. (*British Electric Worcester*)

Kegan Paul, Trench, Trübner & Co, Limited, Technical Publishers, 20 and 22, Charing-Cross-rd, London, W.C. (*Columna London*)

Keiffenheim, H. W., Electrical Engineer, Monaise, Fernwood-rd, Newcastle-on-Tyne

Keighley Electrical Engineering Company, Limited, Electrical Engineers, Bow-st, Keighley, Yorks. (*Electric Keighley*)
See also page 289.

Keith, George, C.E., Supervisor of Cables, and a Director of the Cuba Submarine Telegraph Company, Limited, 58, Old Broad-st, London, E.C.

Kelly, T., Electrician, 22, Park-ter, Markfield-rd, Page Green, Tottenham

Kelso & Co, Manufacturing Electricians and Model Makers, 2, Commerce-st, and 21, Clyde-pl, Glasgow

*Kelvin, The Right Hon. Lord, LL.D., Professor of Natural Philosophy, Glasgow University

Kelvinside Electricity Company, Limited, Electrical Supply Contractors, 28, Renfield-st, and Hyndland, Hughenden-rd, Glasgow
Lord Kelvin ... } Consulting
Dr. J. T. Bottomley ... } Electricians
J. M. Money-Kent, ... Managing Director
J. M. M. Munro ... Electrical Engineer
W. Hannan Watson ... Secretary
See also page 289.

Kelway, C. E., Electrical Apparatus Maker 71 Shardeleos-rd, New Cross, London, S.E.

Kemp (A.) & Son, Copper and Silver Wire Manufacturers, Tenby-st North, Birmingham

Kemp (J.) & Co, Kemp's Mercantile Offices, 46, Cannon-st, and Great St. Thomas Apostle, London, E.C.; and Branches. (*Kemps London*)

Kempe, H. R., A.M.Inst.C.E., Technical Officer, Engineer-in-Chief's Office, General Post Office, London, E.C.

Kempster, J. W., Electrician, 116, Upper Tulse Hill, London, S.W.

Kemsley (Jesse) & Co, Electrical Engineers, 76, Queen's-rd, Bayswater, London, W.

Kendall, J. A., Chemist and Electrician, Lonesome Chemical Works, Streatham Common, London, S.W.

*Kennedy, Prof. Alex. Blackie William, F.R.S., 14, Old Queen-st, Westminster, London, S.W. (*Kinematic London*)

Kennedy (H.) & Son, Engineers and Makers of the "Empress" Turbine, Coleraine, Ireland

Kennedy, Rankin, Electrician and Engineer, Manager Electrical Department, Gwynne & Co, Brooke-st Works, Brooke-st, Holborn, W.C., and 1, Clifton-villas, Camden-sq, N.W., London. (*Gwynnegram London, 2698*)

Kennedy Storage Battery Company, Limited, Makers of the Kennedy Storage Battery, Broad-street House, Old Broad-st, London, E.C. (G. Mortimer Gordon, Secretary)
See also page 289.

Kensington and Knightsbridge Electric Lighting Company, Limited, 148, Brompton-rd, London, S.W. (*3585*)
Granville R. Ryder ... ... Chairman
R. S. Erskine ... ... Secretary
See also page 289.

Kent, A. B., Electrician, 47, Lansdowne-gdns, South Lambeth, London, S.E.

Kent, J. M. V. Money—*see* Money-Kent, J. M. V.

Kent, W. M., Superintendent Commercial Calde Company, Manchester

Kenyon (William) & Sons, Makers of Cotton Driving Ropes, Chapel Field Ropery, Dukinfield, Cheshire. (*Kenyon Dukinfield, 80*)

Keogh, R. W., Electrician, 37, Great George-st, Cork; and Kilkee, R.S.O., co. Clare

Kerr, George A., Electrician, Woodside, Salters-hill, Upper Norwood, London, S.E.

Kerr, Stuart & Co, Portable Railway Manufacturers, California Works, Stoke-on-Trent Staffs.; 20, Bucklersbury, London, E.C.; and Glasgow. (*California Stoke-on-Trent; Meliss London; Meliss Glasgow*)

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Kershaw, Abraham, Electrician, Cankerwell-lane, Leeds

Keswick Electric Light Company, Limited, Court-bldgs, Keswick
W. P. J. Fawcus, C.E. Managing Director
J. R. Dixon ... ... Electrical Engineer
J. Broatch... ... ... Secretary
See also page 280.

Ketley, Frederick W., Electrician, 17B, Great George-st, London, S.W.

Keys (J. W.) & Co, Electrical Engineers, 40 & 42, Lambeth-rd, London, S.E.

Kidby, E. C., Electrician, 1, Darlington-rd, Havelock Park, Southsea, Hants.

Kidd (J.) & Co, Electric Bell Fitters and Gas Engineers, 44, Gray's Inn-rd, London, W.C.

Kidd, William, Consulting Engineer, 10, Westfield-ter, Loftus, R.S.O., Yorks

Kierzkowski-Steuart, Charles F. de, M.I.C.E., Civil and Electrical Engineer, 4, Copthall-bldgs, London, E.C.; and Langley House, Kings Langley, Herts. (*462*)

*Kieser, W., Electrical Engineer (Messrs. Elliott Bros), 101, St. Martin's-lane, London, W.C.

Kiesow & Co, Glass Globe Makers, 25, Forest-avenue, London, E.C. (*Kiesows London*)

Kilgour, Martin Hamilton, Electrical Engineer, 18, Regent-st, Cheltenham

Killarney Electric Light Company, Limited, College-st, Killarney, co. Kerry, Ireland. (Victor A. H. McCowen, Engineer)

Killick & Cochran, Electrical Engineers, 51 and 53, Seel-st, and 54 and 56, Fleet-st, Liverpool

Kincaid, Joseph, Consulting Engineer, 29, Great George-st, Westminster, London, S.W. (*Kincaid London, 3011*)

KINCAID, WALLER & MANVILLE, Consulting Electrical and Civil Engineers, 29, Great George-st, London, S.W. (*Kincaid London, 3011*)

King, Arthur, Maker of Engine Speed Counters and Registers, Pinxton, near Alfreton

King & Co, Electric Light Contractors and Dynamo Makers, Rosebank Electric Works, Broughton-rd, Edinburgh. (*Electric Edinburgh, 16*)

King & Co, Manufacturers of Electric Light Fittings, Market-place, Hull

King, Frederick, Consulting Electrical Engineer, Western Electrical Works, Bristol

*KING, FRANK, M.I.E.E., Electrical Engineer, 39, Victoria-st, London, S.W. (*Consonance London*)

King, H. J. H., Maker of Steam Engines, Turbine Governors, &c., Stroud, Gloucestershire (*King Nailsworth*)

King, James, Electrician, 18, Moodkee-st, Rotherhithe, London, S.E.

King, J. R., Manufacturing Electrician, 11, Albermarle-st, Clerkenwell, London, E.C.

King, Mendham & Co, Electrical Engineers and Manufacturing Electricians, Western Electrical Works, Narrow Wine and Fairfax-sts, Bristol; and 12, Fenchurch-st, London, E.C. (W. B. Allison, Agent.) (*Kingham Bristol, 730*)

King, S., Engineer and Model Maker, Pleasant-row, High-st, Camden Town, London, N.W.

King, Thomas, Consulting Mechanical and Electrical Engineer, 110, Cannon-st, London, E.C.

King, W. F., F.R.S., Electrician, Loanend, Trinity, Edinburgh

King, Wilfred, Secretary Exchange Telegraph Company, Limited, 17 and 18, Cornhill, London, E.C. (*1141*)

Kingdon, J. A., B.A., Electrical Engineer, 29, Marlborough-hill, London, N.W.

Kingdon Yacht, Launch and Engineering Company, Limited, Mechanical and Electrical Engineers, Teddington. (*Kingdon Teddington*)

Kinghorn, W. A., Electrician, 81, St. Vincent-st, Glasgow

Kingsbury, J. E., Manager Western Electric Company, 79, Coleman-st, London, E.C. (*Relay London, 418*)

King's College, Strand, London, W.C. (*For list of Professors, see page 265*)

Kingsland, William, Electrician and Electrical Engineer, 17, Avenue-rd, St. John's Wood, London, N.W.; and Clarence-bldgs, Gloddaeth-st, Llandudno

King-Smith, H., Electrician, Kingsfield, Watford, Herts.

King's Norton Metal Company, Limited, Telegraph Wire Manufacturers, King's Norton, near Birmingham; and 16, Great George-st, London, S.W. (*Metal King's Norton; Outflank London*)

Kingston Engineering Company, Electrical and General Engineers, 2, Russia-row, London, E.C.

Kingswood, W. S., Electrician, Englefield Green, Surrey

Kingzett, C. T., F.I.C., F.C.S., 27, Walbrook, London, E.C.; and Elmstead Knoll, Chislehurst, Kent

Kinninmont (J.) & Sons, Electric Light and Power Contractors and Engineers, 26, Chilworth-st, Westbourne-ter, London, W. Works: 2 and 3, Eastbourne-mews, and Salem-rd, Queen's-rd, London, W.

Kipping, P. P., Electrical Engineer, 34, Allerton-rd, Lordship Park, London, N. (*2654*)

KIRK (WHEATLEY), PRICE & GOULTY, Electrical and Mechanical Auctioneers, Valuers, and Arbitrators, 49, Queen Victoria-st, London, E.C.; and Albert-sq, Manchester. (*Indices London, 1507; Indicator, Manchester*)

Kirk, S. G., Electrician, Victoria-rd, Netherfield, Nottingham

Kirkhams, Battery Jar Manufacturers, London-rd, Stoke-upon-Trent. (*Kirkhams Stoke-on-Trent, 232*)

Kirkaldy (D.) & Son, Testing and Experimenting Works, 99, Southwark-st, London, S.E.

Kirkaldy, John, Limited, Makers of the "Compactum" Heaters and Evaporators and Surface Condensers for High-speed Electric Light Engines, 40, West India Dock-rd, London, E. (*Compactum London, 5094*)

Kirkaldy (John) & Son, Makers of Kirkaldy's Patent Anti-fouling Compositions, East London Works, Garford-st, and Tilbury Docks, London, E. (*Kirkaldy London, 5230*)

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Kitson (Sir James) & Co., Engineers and Boiler Makers, Airedale Foundry, Leeds; and 3, Victoria-st, Westminster, London, S.W.

Kitto, Benedict, F.G.S., F.I.C., Assay Office and Chemical Laboratory, 30 and 31, St Swithin's-lane, London, E.C.

Knap (Conrad) & Co, Engine and Boiler Makers, Lincoln; and 11, Queen Victoria-st, London, E.C. (*Conrad London*)

Knight, Alfred W., Electrician, Cuckfield, and Market-pl, Hayward's Heath, Sussex

Knight & Crowther, Limited, Manufacturers of Specially Prepared Charcoal Sheet Iron for Electrical Purposes, Kidderminster and Brierley Hill. (*Knight Brierley Hill; Crowthers Kidderminster*)

Knight, E. W., Electrical Engineer, Junior Athenæum Club, Piccadilly, London, W.

Knight, F. W. A., Electrical Engineer, 2, Vanbrugh-ter, Blackheath, London, S.E.

Knight, Geo. A., Electrical Engineer, 4, Donaldson-rd, Kilburn, London, N.W.

Knighton, J. G., Consulting Engineer, Staveley Coal and Iron Company, Staveley Works, nr Chesterfield

Knight, J. H., Inventor of the "Knight" Oil Engine, Barfield, nr Farnham, Surrey

Knowles, C. E., Electrician, Holmdale, Glossop

Knowledge (monthly), 326, High Holborn, London, W.C. (Annual subscription, U.K., 6s.)

Koerber, J. A., Electrical and Mechanical Engineer, 44, Frith-st, Shaftesbury-av, London, W.

Koerner, Herman, Electrical Engineer, 58, Oxford-rd, New North-rd, London, N.

Kolle, H. W., A.M.I.C.E., Electrical Engineer, 27, Charterhouse-sq, London E.C.

Kolm, Dr. Chas. A., Lecturer on Chemistry University College, Liverpool

Körting Bros, Gas Engine Makers, 86, Queen-st, Cheapside, London, E.C. (*Korting London*)

Kotyra, M., Electrical Engineer, Representative of Messrs. Ch. Mildé & Co. (of Paris), 60, Watling-st, London, E.C.

Krasa (F.) & Co, Makers of Porcelain Insulators, 7, Wood-street-sq, London, E.C.

Krause, A., Electrician, 42, Hampton-rd, Redland, Bristol

KREIDLER, A., Telegraph Apparatus Maker, Stuttgart, Germany **See Advt. p. 36**

KÜCKE, (W.) & CO, Makers of Tools for Electricians, Elberfeld, Germany. (*No Agents.*) **See Advt., p. 541**

Kugel & Berg, Telegraph Wire Drawers, 10, Jeffrey's-sq, St. Mary Axe, London, E.C.

Kuhn, Ernst, Brass and Copper Wire Manufacturers, 7, Savage-gdns, London, E.C.

Kühn (F.) & Co, General Merchants and Importers, 65, Basinghall-st, London, E.C.

Kunster & Co, Telegraph Wire Makers, 70, Gracechurch-st, London, E.C.

— L —

Lacey, Arthur, Ironmonger and Electrical Apparatus Dealer, Stratford-on-Avon

Lacey, Edwin C., Analytical Chemist, 121, Knight's Hill-rd, W. Norwood, London, S.E.

Lacey, Ernest M., Electrical Engineer, 28, Linden-gdns, Bayswater, London, W.

Lacey, F. W., Electrical Engineer, Central Electric Light Station, Bournemouth

Lackie, William, Electrical Engineer, 75, Waterloo-st, Glasgow

Lacombe & Co—*see* Carbone, Le.

Ladd (John H.) & Co, Engineers, 116, Queen Victoria-st, London, E.C.

Laidler, Thomas, Lightning Conductor Maker, 1, Lee-st, Thomas-st, Limehouse, London, E.

LAKE GIRARD MICA SYSTEM, Ottawa, Canada **See Advt. p. 595**

Lailey, Charles Nicholson, Consulting Engineer, 16, Great George-st, London, S.W.

Laing (James) & Co, Electrical and Mechanical Bellhangers, 120, Union-st, and 50 to 54, Green, Aberdeen

LAING, WHARTON & DOWN, Electric Light Engineers and Contractors, 82A, New Bond-st, W. (*3602*), and 17, Gracechurch-st, E.C. (*1350*), London; 32A, Tower-bldgs, Water-st, Liverpool; and Guardian-bldng, Cross-st, Manchester (*1511*) (*Whardown London; Whardown Manchester*) **See Advt. facing Contents, p. 42**

Laing, Wharton and Down Construction Syndicate, Limited, Electrical Engineers and Contractors, 38, Parliament-street, and Tadema-rd, Chelsea, London, S.W. (Thomson-Houston System of Electric Lighting) (*Asteroidal London, 3016*)

James Devonshire ... Manager and Secretary
Col. Martindale, C.B., .. Chairman

See also page 289.

Laird (John) & Co, Electrical Engineers, Marchmont, Port Glasgow

*Laister, J., M.I.E.E., District Postmaster, Northern District, 46, Essex-rd, London, N.

Lalonde Bros, Electric Bell and Telephone Contractors and Electricians, 2, High-st, Weston-super-Mare

Lamaille (G.) & Co, Shade Makers for Electric Light, 40, Aldermanbury, London, E.C. (*Spurroyal London*)

Lambeth Brass and Iron Company, Limited, Electrical and Mechanical Engineers, Short-st, and 28-31, New Cut, Lambeth, London, S.E.; and at Walsall, Staffs.

Lamb, C. G., B.Sc., Consulting Electrician, Engineering Department, The University, and 33, Regent-st, Cambridge

Lamb, G. M., Electrician and Maker of Wyvern's Dynamo, Woolmarket, Berwick-on-Tweed

Lamb, Horace, M.A., F.R.S., Professor of Mathematics, Owens College, Manchester

Lamb, James, Electrical Engineer, Strathearn House, Crieff

Lamb, J. C., C.M.G., Assistant Secretary (for Telegraphs), General Post Office, London, E.C.

Lamb (Joseph) & Co, Telegraph Glass Makers, 35, Sekforde-st, Clerkenwell, London, E.C.

Lamb (Joseph P.) & Co, Lightning Conductor Manufacturers, 24, Canning-pl, and Wolstenholme-sq, Liverpool

Lambert (Charles) & Co, Copper Smelters, Port Tennant Copper Works, Swansea; and Leadenhall-bldgs, London, E.C. (*Lambert Swansea, 57; Eavesdrop London, 4130*)

Lambert (E.) & Son, Scientific Instrument Makers, 60 and 62, Queen's-rd, Dalston, London, N.E.

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Lamina Accumulator (Elieson's British Patents) Syndicate, Limited, Broad-st-av, London, E.C. (E. Pellas, Secretary). (*Dematllane London*)

Lamonby, H. J., Electrical Apparatus Maker, 52, Graham-rd, Dalston, London, N.E.

Lamp Manufacturing Company, Limited, 12 and 14, Leonard st, City-rd, London, E.C. (I. J. Collins, Managing Director) (*Lampists London, 241*)

Lanaway (Thos.) & Son, Electric Bell Manufacturers, Station-rd, Redhill, Surrey

Lancashire Electric and Engineering Company, Limited, Electrical Engineers and Contractors, 11, Chancery-lane, Bolton, Lancs.
See also page 289.

Lancashire High Conductivity Wire Company, Makers of Electric Wires, St. Helens, Lancs. (London Agent: W. C. Carter, Mansion House-chmbrs, Queen Victoria-st, E.C.) (*Tympanum St. Helens, 39; Tympanum London*)

Lancashire and Yorkshire Electric Lighting Company, Limited, Electric Light Engineers, 5 and 6, St. James's-sq, Manchester
See also page 289.

Lancaster, E. W., Consulting Electrical Engineer, 52, Bristol-rd, Birmingham

Lancaster (J.) & Son, Electrical Instrument Makers, 37, Colmore-row, Birmingham. (*Lankster Birmingham, 216*)

Lander, W. H., Electrician, 33, Blessington-st, Dublin

Land, William, Electric Light Engineer, 43, Broadway, Stratford, London, E.

Lane, D. W., Electrician to the Royal Dockyard, Portsmouth

Lane Fox, St. George, Electrician, 4, Grosvenor-gdns, London, S.W.

Lane, F. W., Electrician and Dealer in Electrical Supplies, Electrical Stores, 67, Cotham Hill, Bristol. (*641*)

Lane, J. M., Electrician, 103, Central-hill, Upper Norwood, London, S.E.

Lang (Jules) & Co, India Rubber Manufacturers, 2, Charterhouse-st, London, E.C. (*Assorted London, 6664*)

*Langdon-Davies, Charles, Electrician and Electrical Engineer, 45, Redcliffe-sq, S. Kensington, London, S.W. (*Langdies London*)

Langdon-Davies, Walter, Consulting Engineer, 57, Comeragh-rd, West Kensington, London, W.

Langdon, William Edward, Telegraph Engineer Midland Railway Company, Derby; and The Lawn, Belper

Lange, Ernest F., Electrical and Mechanical Engineer (Messrs. Beyer, Peacock & Co), Gorton Foundry, Gorton, Manchester (*Lange c/o Loco Gorton, 255*)

Langman, Alfred, A.I.E.E., Electrician, Postal Telegraphs, Mount Pleasant, Clerkenwell, London, E.C.

Langridge, L. J., Surveyor's Department, Economic Fire Office, Limited, 15 and 16, George-st, Mansion House, London, E.C.

Lankester & Son, Limited, Electric Light Engineers and Contractors, High-st, Southampton

Lang, V. R., Superintendent Great Northern Telegraph Company, Aberdeen

Lansard & Co, Press Tool Makers (H. Holme, Proprietor), 216, Goswell-rd, London, E.C.

Larkin, Thomas J., Yamato Villa, Broadhurst Gardens, London, N.W.

Larmor, J., D.Sc., Electrician, St John's College, Cambridge

Larmuth (T.) & Co, Makers of Braiding Machinery for Telegraph and Telephone Wire, Salford, Manchester

Larner, G., Electrician, Darenth, Dartford, Kent

Latch & Batchelor, Limited, Wire Rope Manufacturers, Hay Mills, near Birmingham (*Latch South Yardley, 1063*)

Latham, Ernest, Consulting Engineer, 11, Queen Victoria-st, London, E.C.

LATIMER CLARK, MUIRHEAD & CO, Limited, Electric Light and Telegraph Engineers, Dynamo Machine and Electrical Apparatus Makers, &c, 23, Regency-st, Westminster, London, S.W. (*Regency London.*) **See Advt. facing Preface, p. 59**
See also page 289.

Lauckert, Edward, Electrician, 63, Maryon-rd, New Charlton, Kent

Laughton, Herbert F., 20, Warrington-crescent, Maida Vale, London, W.

LAURENCE, SCOTT & CO, Limited, Electrical Engineers (Makers of the Norwich Dynamos, Shiplighters, Motors, Special Dynamos and Switchboards for the Scott-Sisling System for Private Installations), Gothic Works, Norwich; and 116, Queen-Victoria-st, London, E.C. (*Gothic Norwich, 99*). **See Advt., p. 45.**
W. B. Sisling ... Engineer and Secretary
See also page 289.

Laurence, R., Assoc. M.I.C.E., Electrical Engineer (Laurence, Scott & Co, Limited), Gothic Works, Norwich

Laurie, E. H., Electrician, 16, Blandford-sq, London, N.W.

Laurie, P., Electrician, Dawlish-rd, Selly Oak, Birmingham

Laurie (T.) & Co, Electrical Engineers and Contractors, Falkirk

*Lavender, J., M.S.A., Telegraph Engineer and Electrician, Catherine-chmbrs, 11, Todd-st, Manchester.

LAW RELATING TO ELECTRIC LIGHTING, DIGEST OF—*see full* "Digest" *on pages 88 to 111*

Lawes (John Bennett) & Co, Limited, Chemical Manufacturers, 29, Mincing-lane, E.C., and Atlas Chemical Works, Millwall, E., London. (*Netlaws London*)

Lawrance, R., Electrical Engineer and Contractor, Liskeard, Cornwall

Lawrance, W. J., Ivory and Wood Turner for Electrical Purposes, 9, Giltspur-st, London, E.C.

*Lawrence, H. Newman, Medical Electrician and Specialist, 29, Finborough-rd, South Kensington, London, S.W.

Lawrence, L. S., Electrician, 24, Grove-villas, Poplar, London, E.

Lawson, A. J., Electrical Engineer, Manager Dover Electricity Supply Company, Ltd., 49, Queen Victoria-st, London, E.C. (*Magneto London, 1910*)

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Lawson (Geo.) & Sons, Manufacturers of Electrical Apparatus, Vale Mills, Micklehurst, Mossley, Manchester

Lawson, Roger, Dealer in Electrical Apparatus, Electric and Photographic Stores, Railway Approach, Shepherd's Bush, London, W.

Laycock (W.) & Sons, Leather Driving Band Makers, Queen-st Leather Works, Keighley. (*Laycocks Tanners Keighley, 2246*)

Layton, George, Mechanical Engineer, 29, Kenton-st, London, W.C.

Lea, Frank B., B.A., Electrical Engineer, Westcroft-rd, Carshalton, Surrey

Lea, Frank J., Electrician, Abbey Foregate, Shrewsbury

Lea, Henry, Electrical Inspector to the Birmingham Corporation, Town Hall, and 38, Bennet's-hill, Birmingham

Lea (Henry) & Thornbery, Consulting Mechanical and Electrical Engineers, 38, Bennet's-hill, Birmingham. (*Engineer Birmingham, 113*)

Lea & Perrins, Manufacturers of Electric Light Fittings, Midland Works, Bracebridge-st, Birmingham

Lea, Sons & Co, Electrical Engineers and Manufacturers, Pengwerne Works, and (Showrooms) The Square, Shrewsbury; and 19, Charterhouse-st, London, E.C. (*Lea Sons Shrewsbury*)

Leach, H. L., Superintendent Engineer, St. James and Pall Mall Electric Light Company, Limited, Carnaby-st, Golden-sq, London, W.

Leach (J. S.) & Co, Mechanical and Electrical Engineers, Mount-st Works, Harpurhey, Manchester

Leaf, H. M., Electrician, 51, Locksley-st, Burdett-rd, and (Works) Clarence-st, London, E. (*Locksley London*)

Leahy, C. E., Electrical Engineer, Ballycarty, Tralee, Co. Kerry

Leake, Walter, Electrician, 30, Victoria-bldgs, Manchester, and 35, Dame-st, Dublin

Lean, A. Ll., Electrician (Messrs. J. Davis & Son), All Saints'-Works, Derby.

Leather, John P., Engineer and Manager of the Corporation Gas Department, Burnley

Le Bas (Edward) & Co, Agents for The Mint, Birmingham, Limited, 49 Lime-st, London, E.C.

Le Claire, August, Electrician, 67, Praed-st, London, W.

LECLANCHÉ BATTERY COMPANY, 111 to 117, East 131st-st, New York, U.S.A. **See Advt., p. 448**

LECLANCHÉ & CO, Primary Battery Works. Sole Agent: R. Aylmer, 47, Victoria-st, London, S.W. (*Leclanché London*) **See Advt., p. 17**

Ledger, P. G., Electrician, Mayfield, Eltham-rd, Lee, Kent

Ledward (T.) & Co, Engineers, Makers of Patent Ejector Condensers for Electric Light Stations, Brockley, S.E., and 35, Queen Victoria-st, E.C., London.

Lee, Allen, Practical Electrician and Electrical Engineer, 98, King's-rd, St. Pancras, London, N.W.

Lee Bros, India Rubber Manufacturers, 61 and 62, Barbican, London, E.C.

Lee, Henry, Electrician and Agent for Messrs. B. Verity & Sons, High-st, Burton

Lee, James, Manufacturers of Electric Light Fittings, 57, Theobald's-rd, London, W.C.

Lee, J. H., Electrical Engineer, Southampton Electric Light and Power Company, Ltd., Back-of-the-Walls, Southampton

Lee (Robert A.) & Co, Electrical Engineers and Patent Agents, 203, Shaftesbury-avenue, London, W.C.

Leeds Engineering and Hydraulic Company, Crane and Pump Builders, Providence Works, Leeds. (*Pumps Leeds*)

Leeds Forge Company, Limited, General Engineers and Boiler Makers, Leeds; and 63, Queen Victoria-st, London, E.C. (Samson Fox, C.E., Managing Director) (*Vulpes Leeds*)

Leeds and London Electrical Engineering Company, Limited, Electrical Engineers and Contractors, 15, St. Helen's-pl, London, E.C. Works: Leeds

See also page 289.

Lees, Charles H., B.Sc., Assistant Lecturer in Electrical Technology, Owens College, Manchester

Leeson, J. E., Engineer's Tool Maker, Irlam, Manchester

Leete, Edwards & Norman, Limited, Engineers and Electricians, 366 and 368, Euston-rd, London, N.W.

Le Fevre & Co, Civil and Mechanical Engineers, 26, Budge-row, Cannon-st, London, E.C.

Le Fevre, W. H., Consulting Engineer, 26, Budge-row, Cannon-street, London, E.C.

Légé (A.) & Co, Electric Light Apparatus Makers, 31 and 32, Kirby-st, London, E.C.

Legg, F. G. I., Electrical Engineer, Messrs. Spiers & Pond, Water-lane, New Bridge-st, London, E.C. (*Spierpon London, 2784*)

Legg, John, Telephone Contractor and Electrical Engineer, 17 and 18, Nelson-st, Swansea. (*John Legg Swansea, 96*)

Legg, W. A., Electrician and Consulting Engineer, Manchester Water Works, High Nest, Keswick

Le Grand & Sutcliff, Hydraulic Engineers, Artesian Well Borers, &c., 125, Bunhill-row, London, E.C. (*Abyssinian London*)

Lehmann, T., 38, Hampshire-st, Torriano-avenue, London, N.W.

Original Maker of the "B.A." Standard Screw Thread in Taps, Screw Plates, and Dies; also Maker of Stocks, Gauges, Screws, &c.

Leigh, Henry Harington, Fel.Inst.Ch.P.A., Phillips & Leigh, Patent Agents, 22, Southampton-bldgs, Chancery-lane, London, W.C. (*Rotuceni London, 2791*)

Lennard, F., Electrical Engineer, 22, Coleman-st, London, E.C.

Lennard, F. B., M.A., Electrician, United University Club, Pall-mall East, London, S.W.

Lennon, Rev. Prof., Professor of Natural Philosophy, Maynooth College, Maynooth, Ireland

Leonard, William, Telegraph Engineer, South-Eastern Railway Company, Tunbridge

Leslie, William, Consulting Engineer, 28, Wiltongdns, Glasgow

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Le Souef, Henry John, Electrical Engineer, Aurora Electrical Lighting and Distribution Company, Limited, 54, New Broad-st, London, E.C.

Le Tall, F. W., Electrician, 1, Melford-rd, Lordship-lane, London, S.E.

Levi (Joseph) & Co, Electrical and Scientific Apparatus Makers, 40, Furnival-st, and 2, Dyers'-buildings, Holborn, London, E.C. (*Leviathan London*)

Levi, Samuel Harris, Manufacturer of Electric Toys, 12, Laurence Pountney-la, London, E.C.

Levi (S. J.) & Co., Scientific and Electrical Instrument Makers, 71, Farringdon-rd, London, E.C.

Levin & Rowehl, Creosote Manufacturers, 12, Chapel-st, and Milton-st, London, E.C.

Lewis (Edwin) & Sons, Tube Manufacturers, Wolverhampton, Staffs.; and 143, Fenchurch-st, London, E.C. (*Lewis Wolverhampton*)

Lewis, F. Harman, A.I.E.E., Borough Electrical Engineer, Town Hall, Wolverhampton

Lewis, H. A., B.A., Telegraph Engineer, Telegraph Department, North Staffordshire Railway, Stoke-on-Trent

Lewis, H. F. W., General Manager, London Electric Supply Corporation, Limited, 3, Adelphi-ter, Strand, London, W.C.; and Redlands, Sydenham-rd, Croydon

Lewis, J. Slater, Electrical Engineer, Works Manager W. T. Goolden and Co, Woodfield Works, Harrow-rd, London, W.

Lewis, Joseph, Electrical Engineer, 5 and 6, Great Winchester-st, E.C., and 37, New Oxford-st, W.C., London (*Weatherrane London*)

See "*Lightning Conductor Manufacturers.*"

Lewis, Robert, Electrician, 4, Glenmohr-ter, Hyde Vale, Greenwich, London, S.E.

Lewis (Samuel) & Co, Manufacturers of Nails, Rivets, Bolts, Nuts, &c., Dudley (*Lewis Netherton Dudley*)

Lewis, William T., Electrical Sundriesman, 10, Chryssell-rd, Brixton, London, S.W.

Leyland Rubber Company, Limited, India Rubber Makers, Leyland, near Preston; and at Manchester, Glasgow, and London

Leyshon, John W., Telegraph Engineer, Postal Telegraphs, Cardiff

Libiola Copper Mining Company, Limited, 9, New Broad-st, London, E.C.

Lichtenfeld, Sigismund, Inventor of Electrical Railway Signalling Apparatus, 300, Regent-st, London, W.

Liebert, E. H., Electrical Engineer, c/o E. Liebert, Ivy-villa, Victoria-rd, Manchester

Liepmann Carbon Company, Limited, Carbon Manufacturers, Nelson Wharf, Millwall, London, E. (Henry Liepmann, Ph.D., F.C.S., Managing Director.)

Lightfoot, Thomas Bell, Consulting Engineer, 35, Queen Victoria-st, E.C.

"**LIGHTNING**" (weekly), 11, Queen Victoria-st, London, E.C. Ann. sub., 10s. 6d.) (*Egnicolt London*)

Liley (Wm.) & Co, Electricians, 6, Renshaw-st, Liverpool

Lilley (John) & Son, Scientific Instrument Makers, 10, London-st, London, E.C.

Lilly & Lilly, Limited, Electrical and Sanitary Engineers, 5, Whitcomb-st, Pall Mall East, and Wandsworth-rd, London, S.W.

Limavady Power and Light Works, Largy Mills, Limavady, Ireland. (J. E. Ritter, Manager)

Linay, J. Carter, Electrician, 119 and 255 High-st, and Globe-lane, Chatham

Lironi, Sluice & Co, Electrical and Mechanical Engineers, Berger-rd, Homerton, London, N.E.

Lironi, Vittorio G., Electrical Engineer, Walnut Tree House, Leytonstone

Lister & Co, Engineers' Tool Makers, Beech Cliffe Works, Keighley, Yorks. (*Lister Engineers Keighley*)

Lister, F. L., Electrician, Osborne Villa, Bromley, Kent

LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, Sole Makers of Lithanode and Lithanode Secondary Batteries. Works: 64, Millbank-st, Westminster, S.W. Offices: 11, Abchurch-lane, E.C., London. (*Lithanode London, 1715*) **See Advt., p. 602**

N. Storey Maskelyne, F.R.S. Chairman
J. T. Niblett ... ... General Manager
J. H. Hays ... ... Secretary

See also page 290.

Little, George Herbert, Electrical Engineer, Naval Architect, &c., 1, Talbot-chmbrs, Fenwick-st, Liverpool

Little (Howard B.) & Co, Electrical Instrument Makers, 20, Eldon-rd, Kensington, London, W.

Little, C. W. G., Electrical Engineer, Thomson-Houston International Electric Company, 38, Parliament-st, London, S.W.

Littleboy, T. Graham, Electrical Engineer and Manager English Electric Carbon Company, Limited, Carbon Works, Brymbo, near Wrexham

Livermore, Isaac, India Rubber Manufacturer, 27, Basinghall-st, London, E.C.

Liverpool Electric Supply Company, Limited, Electric Light Contractors, 15, Highfield-st, Liverpool. (*Dynamo Liverpool, 946*)

Arthur Hill Holme ... ... Chairman
A. Bromley Holmes ... ... Managing Engineer
Brierley H. Collins... ... ... Secretary

See also page 290.

Liverpool Gas Fittings Co, Limited, Electric Bell Fitters, &c, Duke-st, Liverpool (John Haynes, Manager) (*Fittings Liverpool, 1961*)

Liverpool Overhead Railway Company, Limited, 24, North John-st, Liverpool (*Harwood Liverpool*)

Sir W. B. Forwood ... ... Chairman
S. B. Cottrell, 31, James-st — Manager (*Motor Liverpool*)
Sir Douglas Fox, M.I.C.E. } Consulting Engineers
J. H. Greathead, M.I.C.E. }
W. H. Alexander ... ... Secretary

See also page 290

Liverpool Physical Society, University College, Liverpool

Ferdinand Hurter, Ph.D. ... President
Rev. F. F. Grensted, M.A. ... } Vice-Presidents
Prof. Oliver Lodge, D.Sc., LL.D., F.R.S. ... ... }
James L. Howard, D.Sc. ... Hon. Secretary

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Liverpool Polytechnic Society, Royal Institution, Colquitt-st, Liverpool

Liverpool Research Laboratory, 18, Albion-st, Everton, Liverpool, (Henry N. Warren, Principal)

Livesey, A., Electrician, 43, Bridge-st, Slaithwaite, Yorks.

Livet & Co, Consulting Engineers, 67, Finsbury-pavement, London, E.C.

Livingstone, J., Assistant Professor of Electrical Engineering, Glasgow and West of Scotland Technical College, 38, Bath-st, Glasgow

Livingston, James, Metal Merchant, 34, Gracechurch-st, London, E.C. (*Livingston London, 1368*)

Lixa Mining Company, Limited, Antimony Refiners, 6, Great St. Helen's, London, E.C. (J. Foster, Secretary)

Llanelly Electric Light and Power Company, Limited, New Dock, Llanelly. (*Electric Llanelly, 312*)

See also page 390.

Llewellin & James, Makers of Day's Gas Engine, Castle-grn, Bristol. (*Llewellin James Bristol*)

Llewellin's Machine Company, Makers of Electrical Time-Checking Specialities, Bristol (*Llewellins Bristol*)

Lloyd, C. Oliver, Electrician, 39, Wellesley-rd, Wanstead, Essex

Lloyd & Davis, Engineers, 64, Sumner-st, Southwark, London, S.E. (*Exhausters London*)

Lloyd & Lloyd, Sole Licensees of the Benardos Patents for Electric Welding, Nile-st, Birmingham. (*Lloyds Birmingham, 284*)

Lloyd, Robert S., Electrician, 90 and 92, Whitecross-st, London, E.C.

Lloyd, W. B., Electrician, "Bella Vista," Southwood Lawn-road, Highgate, London, N.

Loach & Clarke, Makers of Electric Light Fittings, 20-25, Essington-st, Birmingham

Lobenthal & Co, Electric Carbon Manufacturers, 66 & 67, Milton-st, London, E.C.

LOCAL AUTHORITIES (London and Provincial), Chief Officials of—*see pages 334 to 352*

The list is specially prepared for this Directory, and is corrected up to January, 1894.

LOCAL GOVERNMENT BOARD, Whitehall-gdns, London, S.W. (*For Officials, see p. 331*)

Loch, David, Electrician, 55, Calvert-rd, East Greenwich, London, S.E.

Lock, W. B., Electrician, 15 & 16, Norfolk-st, King's Lynn. (*Lock Electrician King's Lynn*)

Lockerbie & Wilkinson, Electrical Apparatus Makers, Birmingham. (London Agent, G. Stegmann, *q.v.*)

Lockhart, W. S., Electrician, 67, Granville-park, Blackheath, London, S.E.

Lockie, John, C.E., Civil Engineer, and Editor of *The Steamship*, 2, Custom House-chmbrs, Leith. (*Lockie Leith*)

Lockwood (Crosby) & Son—*see* Crosby Lockwood & Son

Lockyer, N. J., Electrician, Lenzie, N.B.

Lockyer (W. A.) & Co., Electricians, Merstham, Redhill, Surrey. (*Electricity Merstham*)

Lodge, Alfred, Electrician, Cooper's Hill College, Staines, Middlesex

*Lodge, Prof. Oliver J., D.Sc., F.R.S., M.I.E.E. (Professor of Physics, University College, Liverpool), 2, Grove-park, Liverpool

Loeffler, Ludwig, Civil Engineer, 12, Queen Anne's-gate, Westminster, London, S.W.

Logan and Co, Copper Smelters and Refiners, Copper Wharf, Birkenhead. (*Logan Birkenhead, 4968*)

Login, Louis C., Electrical Engineer, 7, Randolph-cliff, Edinburgh

London Arc Lamp Company, Electrical and General Engineer, 35, Grafton-st, Fitzroy-sq., London, W.

London Asbestos Company, Asbestos Manufacturers, 101, Leadenhall-st, London, E.C.

London Association of Foremen Engineers and Draughtsmen, Cannon-st Hotel, Cannon-st, London, E.C. (Wm. Powrie, Secretary)

London Battery Company, Limited—*in liquidation*. (H. G. Ellis, 1 and 2, Marlborough-st, Great Charlotte-st, Blackfriars, London, S.E., Liquidator)

See also page 390.

London and Birmingham Manufacturing Company, Limited, Electrical Engineers and Tool Makers, 39, Upper Thames-st, London, E.C. (J. Burford, Managing Director)

London and Brighton Engineering Company, Electric Light Engineers, 7 and 8, Pavilion-bldgs, and 10, Circus-st, Brighton

London Central College of Electrical Engineering and Land and Submarine Telegraphy, 117, Coldharbour-lane, London, S.E. (Edward Bull, Manager)

LONDON CHAMBER OF COMMERCE, Botolph House, Eastcheap, London, E.C. (Henric B. Murray, Secretary.) (*Convention London, 1160*)

(*For Objects of the Electrical and Allied Trades Section, see page 263.*)

London Chemical Company, Acid Manufacturers, Bow Bridge Wharf, London, E. (*Tested London, 3429*)

London (City of) Electric Lighting Company, Limited—*see* City of London Electric Lighting Company

London (County of) Electric Lighting Company, Limited—*see* County of London and Brush Provincial Electric Lighting Company, Limited

LONDON COUNTY COUNCIL, Spring-gardens, S.W., and (Stores) 23, Belvedere-rd, Lambeth, S.E., London. (*4615*)

John Hutton ... ... Chairman
Charles Harrison... ... ... Vice-Chairman
W. H. Dickinson... ... ... Deputy-Chairman
Prof. W. Garnett } Technical Adviser to the Technical Education Committee.
A. R. Binnie ... ... Engineer
E. Bazalgette ... ... } District
Hart Bennett ... ... } Engineers
J. E. Worth ... ...
E. T. Atkinson ... ... Mechanical Engineer
W. J. Dibdin, F.I.C., F.C.S.... Chemist
T. Blashill ... ... Sup. Architect
Thomas Holloway ... ... } Manager of Works & Stores
H. De la Hooke ... ... Clerk
A. Young ... ... Valuer
A. Spencer, Chief Officer Pub. Control Dept.
J. J. Sexby, Chief Officer, Parks Dept.

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London Electric Supply Corporation, Limited, 3, Adelphi-ter, W.C. (*Generator London, 3800*), and Stowage Wharf, Deptford, S.E. (*Gignentia London*), London
J. Staats Forbes .. Chairman
R. Stewart Bain .. Secretary and Accountant
H. F. Lewis ... General Manager
P. W. D'Alton... Engineer
See also page 290.

LONDON ELECTRIC WIRE COMPANY, Limited, Wire Manufacturers and Coverers, Anchor Works, Playhouse-yd, Golden-lane, London, E.C. (*Electric London, 105*) **See Advt., p. 12**
See also page 290.

London Electrical Manufacturing Company. Manufacturers of Electrical Apparatus, 41, St. John's Hill, Clapham Junction, London.

London Electro-Plating and Refining Company. Electro-Platers and Refiners, St. John's-passage, St. John's-sq, Clerkenwell, London, E.C. (A. V. Pittar, Manager)

London and Glasgow Engineering and Iron Shipbuilding Company, Limited, Engineers and Boiler Makers, &c, 49, Anderston-quay, Glasgow. (*Middleton Glasgow*)

London and Hampstead Battery Company, Limited, Electricians, Electrical Engineers and Contractors, &c., 15A, Fitzjohn's-pavement, Finchley-rd, London, N.W.
A. W. Armstrong ... ... Manager
A. H. Howard ... ... Engineer
See also page 290.

London and Lancashire Electric and General Engineering Company, Limited, Electrical and General Engineers, Kingsland-green, London, N.E. (C.N. Russell, Engineer and Manager.) (*Pryke London, 608*)
See also page 290.

London Lathe and Tool Company, 37, Pomeroy-st, New Cross, London, S.E.

London Metallurgical Company, Limited—*in liquidation.* (Stuart Bogle, A.C.A., Copthall-avenue, London, E.C., Liquidator)

LONDON PLATINO-BRAZILIAN TELEGRAPH COMPANY, Limited, 19, Great Winchester-st, London, E.C.
W. S. Andrews ... ... Chairman
Major A. Wood ... ... Managing Director
R. M. Cunningham ... Secretary
See also page 290.

London and Suburban Messenger and General Agency Company, Limited, 105, Hatton-gdn, and 3A, Bolt-court, Fleet-st, E.C. (*6757*)

London (W. F.) & Co, Electric Light Engineers and Contractors, 51, Bishopsgate-st Within, E.C., and 19, Steward-st, Spitalfields, E., London

London Zinc Mills, Limited, Zinc Rolling Mills, Wenlock-rd, London, N. (*Zinc Mills London*)

Long, F. M., Engineer and Manager, Norwich Electricity Company's Central Station, Norwich

Long, Thomas E. (late Liddiard & Wondley, Limited), Electrician, 6 and 7, Bank-bldgs, Hastings

Longden & Co, Art Metal Workers, 447, Oxford-st, London, W.: and Phœnix Foundry, Sheffield. (*Telegram London*)

Longford Wire, Iron, and Steel Company, Limited, Wire Makers and Drawers, 61, St. Mary Axe, E.C.; and Dullam-lane, Warrington. (*Longford Warrington, 92*)

Longmans, Green & Co, Technical Publishers, 39, Paternoster-row, London, E.C. (*Longmans London*)

Lord, J. C. & W., Turbine Makers, 52, Leadenhall-st, London, E.C.

Lord (William Turner) & Co, Electric Light Contractors, 120, Mount-st, Grosvenor-sq, London, W.

Lorenz, Hugo, Chemical Merchant, 7 and 8, Idol-lane, London, E.C. (*Lorenz London*)

*LORRAIN, J. G., M.I.E.E., M.Inst.M.E., Fellow of the Chartered Institute of Patent Agents, Norfolk House, Norfolk-st, Strand, London, W.C. (*Lorrain London*) **See Advt., p. 573**

Lott & Prichard, Electrical Engineers, 70, Park-st, Camden Town, London, N.W.

Lotz, Abbott & Co, Lathe and Tool Makers, 144, High Holborn, London, W.C.

Louden, E. R., Electrician, Windsor-ter, Uplands, Swansea

Louth, W., Superintending Engineer, Postal Telegraphs, Dublin

Lovelace, Henry, Electrical Engineer, 7, Gerrard-st, Soho, London, W.

Lovett, Thomas, Electrician, 15, Kilbowie-rd, Clydebank, Glasgow

Lovey, A. Feri, Electrician, 20, The Common, Woolwich, London, S.E.

Lowcock, Hill & Co, Manufacturing Electrical Engineers, 2, St. James's-sq, Blackpool

Lowdon Bros, Electrical Engineers, 21, North Tay-st, and 72, Commercial-st, Dundee. (*Lowdon Brothers Dundee*)

Lowdon, David, Marine and Electrical Engineer, Barry Graving Dock and Engineering Co 23, Kingsland-crescent, Barry, Cardiff

Lowdon, E. J. B., Electrician, 21, Airlie Place, Dundee

Lowndes, Charles E., Electrician, 27, St. Maur-rd, Fulham, London, W.

Lowrance (M.) & Son, Manufacturing Electricians, Peel-sq, and Market-st, Barnsley

Lowry, W., Electrical Engineer, Mellier & Co, 48 to 50, Margaret-st, Cavendish-sq, London, W. (*Wheelrace London*)

Lucas, C., Electrical Engineer, White Hart Hotel, Windsor

Lucas & Davies, Mechanical and Scientific Model Makers, 67, Farringdon-rd, London, E.C.

Lucas (Edward) & Son, Malleable Iron Founders, Dronfield Foundry, near Sheffield. (*Lucas Dronfield, 1007*)

Lucas, F. R., Engineer-in-Chief, Telegraph Construction and Maintenance Company, Limited, Enderby's Wharf, Greenwich, London, S.E.; and Green Hall, Forest Row, Sussex

Lucas, R. N., Electrician and Technical Translator, Clareville, Galway

Lucas, William, M.A., Electrician, 53, Thornhill-sq, Barnsbury, London, N.

Luke, H., Electric Bell Manufacturer, &c., 11, Brazenose-street, Manchester

Lumsden, D., Submarine Superintendent, General Post Office, London, E.C.

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*LUNDBERG, ANDRÉ PETER, Manufacturer of Electric Light Fittings, Inventor, Patentee, and Manufacturer of the "UNIQUE" Switch and its modifications, Main and Branch Switches, Wall Sockets, Cut-Outs, Ceiling Roses, &c., Bradbury Electrical Works, Bradbury-st, Kingsland, London, N. (*Lundberg London*) **See Advt., p. 619**

*Lundberg, Gus. C., Electrical Engineer, Bradbury Works, Bradbury-st, Kingsland, London, N. (*Lundberg London*)

Lundberg, P. A., Electrician, Bradbury Electrical Works, Bradbury-st, High-st, Kingsland, London, N. (*Lundberg London*)

Lund Bros. & Co., Electrical Engineers and Contractors, 123 & 125, Oxford-st, London, W.

Lund, Richard, Agent for Electrical Glassware, 123-125, Oxford-st, London, W.

Lupton, K. & H., Engineers and Machine Tool Makers, Well-st, Coventry. (*Luptons Coventry*)

Luraschi, Alex., Glass Blower, 15, Cross-st, Hatton-gdn, London, E.C.

Luttrel-Elward, H., Electrician, 17, Portland-pl, Royal Canal, Dublin

Lyall, James, Consulting Engineer, 3, Clifford-st, Glasgow

Lydall, F., Electrician, Siemens' Laboratory, King's College, Strand, London, W.C.

Lynd, W., Electrical Engineer, Manager Young's Phonograph Depôt, 52, Fore-st, E.C., and 132, Adelaide-rd, South Hampstead, N.W., London

Lynde, Frederick C., Consulting Engineer, 9, Victoria-st, London, S.W.; and 25, Cross-st, Manchester.

Lyon, H. C., Electrician, 616, Mile End-road, Bow, London, E.

Lysaght (John), Limited, Wire Makers and Drawers, St. Vincent Works, Bristol; 36, Gracechurch-street, London, E.C.; and at Wolverhampton. (*Lysaght Bristol, 176; Lysaght London, 1464; Lysaght Wolverhampton*)

Lyster, C. F., Consulting Engineer, Mersey Dock Estate, Dock-yard, Liverpool

— M —

Mabon (A.) & Co, Electricians and Model Makers, 10, West Campbell-st, Glasgow

Macaskill, —, Electrician, 58, Chancellor's-rd, Hammersmith, London, W.

Maccallum, John Malcolm, Electro-Chemist, 21, Bentinck-st, Greenock

MACCARTHY, C. C., Electrical Engineer, Manufacturer and Contractor, The Belfast Electrical Works, 23, Corporation-sq., and 16, William-st South, Belfast. (*556*) **See Advt. p. 49**

McCarthy, Wm. Henry, Scientific Instrument Maker, 9, Mount-pleasant, London, W.C.

McCausland, H. A., Electric Light and Power Engineer, 122, Sinclair-rd, Kensington, London, W.

McClelland, James, Representative of Messrs. W. H. Allen & Co., Queen's-rd, and Donega Quay, Belfast. (*Lela Belfast, 717*)

McClellan, & Co., Electrical Engineers, 35, Ludgate-hill, London, E.C.

McCormacks, Limited, Electrical and Mechanical Engineers, Paignton, and Torquay, Devon

McCowen, Victor A. H., Electrical Engineer, Killarney Electric Light Co., Limited, Killarney; and Barrow House, Tralee, co. Kerry, Ireland

McCraith, Jeremiah, Electrician, The Elms, Melton Mowbray, Leicestershire

McCulloch, Sons & Kennedy, Limited—*in liquidation*

Macdermott, J., Electrician, 10, Rochdale rd, Oldham

Macdonald & Co., Electrical Engineers, 29, Piccadilly, Manchester

Macdonald, E. W. J., Electrical Engineer, Metropolitan Electric Supply Co., Limited, 17, South-st, Manchester-sq, London, W.

*Macdonald, the Right Hon. J. H. A., Q.C., C.B., LL.D., D.L., F.R.SS. (L. and E.), M.I.E.E., late Pres. Roy. Scot. Soc. of Arts, Lord Justice-Clerk of Scotland, Inventor of the Holophote Course Indicator for Vessels at Sea, and a Portable Field Telegraph for the use of Armies in the Field, 15, Abercromby-pl, Edinburgh (*196*)

McDowell, R. W. H., Steam Packing Manufacturer, 11, Bow-lane, London, E.C. (*McDowell London*)

McElroy, John, Electrician, 57, Clare-st, Limerick

McEvoy, Capt. C. A., Electrical and Torpedo Engineer, 69, Victoria-street, London, S.W.

Macfarlane (Andrew) & Co, Engineers, Oil and General Merchants, 59, Southwark Bridge-rd, London, S.E.; and 18, John-st, Sunderland. (*Officials London, 4887; Officials Sunderland, 658*)

Macfarlane Bros., Makers of Enamelled Iron Reflectors, 11, Springfield-court, Buchanan-st, and 26, Oswald-st, Glasgow. (*Enamel Glasgow, 4593*)

McFarlane, James, Manager to Munro's Electrical Manufacturing Co., Limited, 9, Holland-pl, Glasgow

McFarlane, Norman, Resident Engineer, Central Electric Light Station, Glasgow

Macfarlane, Strang & Co., Limited, Makers of Cast Iron Pipes, Lochburn Iron Works, Glasgow

Macfarlane (Walter) & Co, Architectural and General Iron Founders, Saracen Foundry, Possilpark, Glasgow. (*Saracen Glasgow, 4497*)

Macfee, John, Jun., Local Manager National Telephone Company, Limited, 8, Exchange-st, Sheffield

McGaw & Co, Moulding and Wood Casing Manufacturers for Electricians, York-rd, and York-street, Lambeth, London, S.E. (*4805*)

M'Geoch (W.) & Co, Electric Light Fittings Makers, 46, Coventry-rd, Birmingham and at London and Glasgow. (*M'Geoch Birmingham, 477*)

M'Ghie & Co, Electricians and Electric Bell Makers, 75, St. Vincent-street, Glasgow (*5607*)

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McGrath, E., Superintendent Eastern Telegraph Company, 20, Brown-st. Manchester

McGrath, J., Electrician, Mount Sydney, Wellington-pl, Dublin

McGregor, Josiah, Consulting Engineer, 78, Queen Victoria-st, London, E.C. (*Sahib London*)

*McGregor, William, Telegraph and Lightning Engineer, Managing Director of the Polytechnic, Bournemouth. (*Polytechnic Bournemouth*)

Machinery and Hardware Company, Limited—*now* John H. Hackworth & Co (*q.v.*)

Machinery: the Iron and Steel Trades Review and Implement News (monthly), 50, Strand, London, W.C. (Ann. sub., 8s. 6d.) (*Registro London*)

Machinery Market and Exporter (monthly), 171, Queen Victoria-st, London, E.C. (Ann. sub., 6s.)

Machinery Purchase-Hire Company, Machinery Dealers, 46, Queen Victoria-st, London, E.C. (*Plant London*)

Machinery Users' Association, 8, Laurence Pountney-hill, Cannon-st, London, E.C.; and 16, Deansgate, Manchester. (G. Humphreys-Davies, F.S.I., Secretary.) (*Rateable London, 1608*)

McInnes, C. F., Consulting Electrician, Managing Director of the English Electric Manufacturing Co, Limited, 30, Stamford-st, Leicester. (*Electron Leicester*)

McInnes, Ledbetter & Co, Electrical Engineers and Contractors, 30, Stamford-st, Leicester (*McInnes Electrician Leicester*)

McInnes (T. S.) & Co, Limited, Electrical and Scientific Instrument Makers, 86, York-st, and 341, Argyle-st, Glasgow. (*Indicator Glasgow, 3979*)

Macintosh (Chas.) & Co, Limited, India Rubber Manufacturers, Cambridge-st, Manchester; 30, Fore-st, London, E.C.; and at Liverpool and Glasgow. (*Macintosh Manchester, 267; Lark London*)

McIntosh (Peter) & Sons, Link Belt Driving Band Makers, 129, Stockwell-st, Glasgow. (*Macintosh Glasgow, 853*)

MacIntosh, F., Electrical Engineer, 38, Langham-st, Portland-pl, London, W.

McIntosh, J., Electric Light Engineer and Bell Fitter, 38, Langham-st, London, W.

Macintyre (James) & Co, Limited, Manufacturers of China Porcelain for Electricians, Washington Works, Burslem, Staffs.; and 49, Holborn-viaduct, London, E.C. (*Macintyre Burslem*)

Mackay, Alex. Ross, Electrical and General Engineer, 10, Graham-st, Edinburgh

Mackail, J. H., Electrician, Messrs. Johnson & Phillips, 66, Delafield-rd, Old Charlton, Kent

McKenzie & Holland, Railway Signal Manufacturers, 61, Sinclair-rd, West Kensington-pk, London, W.; and Vulcan Iron Works, Worcester. (*Holland Worcester*; *Interlocking London*)

Mackenzie, James, Electrical Engineer, 17, Beaconsfield-rd, Ealing, London, W.

Mackenzie, J. Kenneth D., Consulting Electrical Engineer, Broadway-chmbrs, Westminster, and 15, Redcliffe-sq, London, S.W.

Mackey, Mackey & Co, Manufacturing Chemists, &c., 1 and 2, Bouverie-street, Fleet-street, London, E.C.

Mackie, Mackie & Co., Electrical Engineers, 7, Portpool-lane, Holborn, London, E.C.

Mackie, William, Electrical Engineer, Turk's Head-yard, 77, Turnmill-st, London, E.C. (*6620*)

Mackies, Limited, Electrical Engineers, Pulley and Shafting Makers, Berks Iron Works, Reading. (*Mackie Reading*)

Mackinlay (J. C.), King Smith and Co, Electric Light Contractors, Iron and Metal Merchants, 24, Upper Thames-st, London, E.C. (*Bodmac London*)

McKinnon, J., Electric Bell and Telephone Fitter, 150, James-st., Bridgeton, Glasgow (*2649*)

Mackrill (E. T.) & Co, Electrical Engineers, 178, Wardour-st, Soho, London, W., and Kingsbury-sq, Aylesbury, Bucks.

McLachlan, E. A., Electrical Engineer 55, Brighton-rd, Stoke Newington, London, N.

MacLaren (J.) & Co., Electrical and Mechanical Engineers, 34, St. Andrew-sq, Edinburgh

McLauchlen, S. L. D., Electrical Engineer, Birmingham Electric Supply Co., Limited, 14, Dale-end, Birmingham

McLaughlin, S. W., Electrical Engineer, 1, Booth-st, Handsworth, Staffs.

MacLay, Alexander, B.Sc., C.E., Consulting Engineer and Professor of Mechanical Engineering, Glasgow and West of Scotland Technical College, Glasgow

McLean, Donald, Telegraph Engineer, Post Office, Helensburgh, N.B.

McLean, J. H., Engineer to the Oxford Electric Company, Limited, 45, Broad-st, Oxford

Maclean, Magnus, M.A., F.R.S.E., Consulting Electrician, Physical and Electrical Laboratory, The University, Glasgow

McLean (R. A.) & Co, Agents for the Manitoba Electric and Gas Light Company, Limited, 1, Queen Victoria-st, London, E.C. (*Etruscan London, 1683*)

McLean's Telegraphic News Exchange, Telegraphic News Agency, St. Stephen's-chmbrs, Telegraph-st, London, E.C.

MacLellan (A.) & Co, Electrical Engineers, Contractors, and Manufacturers, 54 and 56, Waterloo-st, Glasgow

McLellan, John, Electrical and Telephone Engineer, 37, Northgate, Blackburn

Macleod (A.) & Co, Electrical Engineers, 3, Dundas-st, Glasgow (*Am Glasgow, 1221*); and 28, Commercial-st, Dundee

McLeod, Prof. Herbert, F.R.S., F.C.S., Professor of Chemistry at Royal Indian Engineering College, Cooper's Hill, near Staines

MacMahon, Major P. A., R.A., F.R.S., Electrician, Artillery College, Woolwich, Kent; and 40, Shaftesbury-avenue, London, W.

McMahon, P. V., Assistant Engineer, City and South London Railway Company, Limited, 195, Clapham-rd, London, S.W.

McMaster, James, Electrician, Nether Lea, Llandudno

Macmillan & Co, Technical Publishers, 29 and 30, Bedford-st, Covent-gdn, London, W.C. (*Publish London, 2686*)

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Macmuldrow, W. G. P. Electric Inspector to the Corporation of Liverpool, City Laboratory, and 4, Alexandra-drive, Sefton Park, Liverpool

McMichael, John A., B.A., Lecturer on Magnetism and Electricity, School of Science and Art Technical Schools, Grosvenor Museum, Chester

McMullen, J. A., M.I.E.E., Consulting Electrical Engineer, 21, Carlton-hill, St. John's Wood, London, N.W.

McNaughton, D., Sole Agent in Great Britain and Ireland of Electricaté et Hydraulique (Charleroi, Belgium), 79, Mark-lane, London, E.C.

M'Onie, Harvey & Co, Limited, Engineers and Machine Tool Makers, 224, West-st, Glasgow (*Maconie Glasgow, 565*)

McPherson, W., Electrician, 42, Chalcot-crescent, Regent's Park, London, N.W.

MacQueen Bros, Manganese Merchants, 11, Old Jewry-chmbrs, London, E.C. (*Macqueen London*)

McWhirter, William, M.I.E.E., Consulting Electrical Engineer and Electrician, Managing Director of the Faraday Electrical Engineering Co, Ltd, Govan, Glasgow; and 3, Trinity-st, Aberdeen (*Faraday Glasgow, 1703; Faraday Aberdeen*)

McWhirter, Roberts & Co, Manufacturers of Cable Lamps, Tools, and Fittings, 249 to 251, East India Dock-rd, London, E. (*McWhirter London*)

MacWilliam, G. G. (London and Export Agent for C. Thompson Maling & Sons, Insulator, Porous Cell, and Battery Jar Makers, Newcastle), 20, Bartlett's-bldgs, London, E.C.

Maddox, A. G., Professor of Electricity, City of London Young Men's Christian Association, 186, Aldersgate-st, London, E.C.

Madgen, Frederic J., Electrician, 26, Suffolk-st, Pall Mall East, London, S.W.

Madgen, William Leonard, Consulting Engineer, Faraday House, 8 and 10, Charing Cross-rd, London, W.C.

Madras Electric Tramways Company, Limited, 1, Trafalgar-bldgs, Northumberland-av, London, W.C.

W. Digby, C.I.E. ... ... Chairman
S. A. Chalk ... ... Managing Director

See also page 291.

Maginnis, J. P., Consulting Engineer, 9, Carteret-st, Westminster, London, S.W.

Magnolia Anti-Friction Metal Company of Great Britain, 75, Queen Victoria-st, London, E.C. (W. E. Watson, Secretary) (*Smoothly London*)

Magnus, Sir Philip, Kt., B.Sc., 48, Gloucester-pl, Portman-sq, London, W.

Maguire, J., Electrician, 43, Watling-street, Dublin

*Maier, Julius, Ph.D., Electrical Engineer, 20, Bucklersbury, E.C., and 23, Melrose-gdns, West Kensington-park, W., London.

Maigatter, Carl, Brass and Copper Wire Merchant, Billiter-sq-bldgs, London, E.C. (*Maigatter, 4169*)

Main, J., Electrical Apparatus Manufacturer, 98, Barrington-rd, Brixton, London, S.W.

Mair, James, Wh.Sc., Consulting Engineer, 30, Inverleith-row, Edinburgh

Malan, E. de M., Telegraph Engineer, Hull and Barnsley Railway Company, Alexandra Dock, Hull

Malcolm, E. D., Col. R.E., C.B., F.R.G.S., M.Phys.Soc., &c, Ardchonnell Lodge, Oban, Argyleshire

Maling (Christopher Thompson) & Sons, Porous Cell and Battery Jar Makers, Ford Potteries, Newcastle-on-Tyne

Maling, Frederick T., Electrician, 14, Ellison-place, Newcastle-on-Tyne

Mallinson, Thomas, Wire Manufacturer, 139, St. Paul's-rd, Bow Common, London, E.

Manby, Edward, Electrician, 3, Eastbourne-ter, London, W.

*Mance, Sir Henry C., C.I.E., M.Inst.C.E., M.I.E.E., Consulting Electrical Engineer, Director of the West African Telegraph Company, Limited, Winchester House, Old Broad-st, London, E.C.

MANCHESTER EDISON-SWAN COMPANY, Limited, Electric Light Engineers, (Offices) Temple-chmbrs, 29, Brazenose-st, (Showrooms and Stores) Exchange Station-approach, Victoria-street, and (Works) 27, Little John-st, Deansgate, Manchester. (*Edison Manchester, 532*) **See Advt., p. 10**

V. K. Armitage ... Chairman
W. P. J. Fawcus ... Managing Director
John E. Sharples ... Secretary

See also page 291

Manchester Municipal Technical School, Princess-st (Electrical Engineering Branch, Whitworth-st), Manchester. (*Nat. 2259 and 397, New 22*) (*For Professors, &c., see page 272*

Manchester Ship Canal Company, 41, Spring-gdns, Manchester. (*Canal Manchester, 688.*) Carrying Department: Bridgwater Canals Undertaking. Chief Office: Chester-rd. (*Quay Manchester, 788*)

Manganese Bronze and Brass Company, Limited, Makers of Manganese Bronze Wires, &c., St. George's-wharf, Deptford, S.E., 73, Lombard-st, E.C., and 49 and 50, St. George's House, Eastcheap, London. (*St. George London, 8009*)

Manitoba Electric and Gas Light Company of Canada, Limited. London Office 1, Queen Victoria-st, London, E.C. (R. A. McLean & Co, Agents) (*1683*)

See also page 291

Manley, J. W., Electrical Engineer, 7, Thayer-st, Manchester-sq, London, W.

Manlove, Alliott & Co, Limited, Engineers, Bloomsgrove Works, Nottingham; and at London (*Manloves Nottingham, 274*)

Mann, E., Electrician, Palace-chmbrs, 9, Bridge-st, Westminster, London, S.W.

Mann, Geo. Edward, Electrician, Baker-st, Enfield

Mann, J. J., Electrician, Peel Mills, Manchester

Mann, John, C.A., Secretary to the River Plate Telegraph Company, Limited, 188. St. Vincent-street, Glasgow. (*Manuca Glasgow, 1368*)

Manners, H., Electrician, 80, New Kent-rd, London, S.E.

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Mannheim India-Rubber, Gutta-Percha and Asbestos Works Co., India-Rubber, Vulcanite and Asbestos Manufacturers, 108, Bishopsgate-st Within, London, E.C.

Manson, W., Assistant Electrician, Great Northern Telegraph Company, Aberdeen

MANVILLE, EDWARD—*see* Kincaid, Waller and Manville

Maple & Co., Limited, Electric Light Engineers, 141 to 149, Tottenham Court-rd, London, W.C. (*3605 & 558*)

Maples, George Alfred, Coppersmith and Brazier, 222, Walworth-rd, London S.E.

Mapplebeck (Howard) & Co, Leather Driving Band Makers, 12 and 14, Bath-row, Birmingham (*Saddlery Birmingham, 864*)

Maquay Electric Light Company, Electric Light Engineers and Contractors, Makers of the Maquay Primary Battery, &c., 180, Wardour-st, London, W.

Marchant, Young & Co., Limited, Electrical and General Engineers, 166, Clerkenwell-rd, London, E.C. (*Rotating London*)

See also p. 291.

Margesson, Mortimer R., Managing Director International Electric Subway Company. Limited, 39, Victoria-st, London, S.W. (*Evolve London, 3262*)

Marillier, Harry C., Electrical Engineer, 36, Rossetti-mansions, Chelsea, London, S.W.

Markby, Walter, Electrical Engineer, 155, Westbourne-ter, London, W.

Marr, A., Electrical and Telephone Engineer, Collier-Marr Telephone and Electrical Manufacturing Company, Limited, Derby-st, Oxford-rd, Manchester

Marr (J. J.) & Co, Electric Light Engineers and Contractors, 18, Moorfields, Liverpool. (*Marr Moorfields Liverpool, 1777*)

Marriott, Wm., Assist. Sec. Royal Meteorological Society, 22, Great George-st, London, S.W.

MARRYAT, LILLYWHITE & CO., Manufacturing Electrical Engineers, 57, Hatton-gdn, London, E.C.

Marsden, A., Electrical Engineer, c/o Paterson & Cooper, European Works, Pownall-rd, Dalston, London, N.E.

Marsh, H., Electrical Engineer, 107, Churchlane, Charlton, Kent

Marsh, Jones & Cribb, Manufacturers of Electric Light Fittings, Boar-lane, and (Works) Basinghall-st, Leeds

Marsh, T. A., Electrical Engineer, 69, Brookgrn, Hammersmith, London, W.

Marsh, T. E., Electrician, 42, Reighton-rd, Upper Clapton, London, N.E.

Marshall, A. W., Electrician, 180, Loughborough-rd, Brixton, London, S.W.

Marshall & Co., Electrical Engineers, 28, St. Saviour's-gate, York; and Treleyholme, Franklin-rd, Harrogate

Marshall, Fleming & Jack, Engineers, Manufacturers of Electric, Steam and Hydraulic Cranes, Dellburn Works, Motherwell, near Glasgow; and 34, Queen Victoria-st, London, E.C. (*Dellburn Motherwell*)

Marshall, Sons & Co, Limited, Steam Engine Makers, Gainsborough, Lincolnshire; and 79, Farringdon-rd, London, E.C. (*Marshalls Gainsboro'; Engine London, 6648*)

Marson (F.) & Co, Manufacturing Electricians, King Richard's-rd, Leicester

Marson, Francis, Scientific Instrument Maker, 32, Clerkenwell-green, London, E.C.

Martin & Co, Engineers and Manufacturers of Dynamo Castings, 75, East-road, West Ham, London, E.

Martin, W. G., Electrician, 102, High-st, Stoke Newington, London, N.

Martin & Son, Engineers and Metal Workers, Vine-st, York-rd, Lambeth, London, S.E.

Martin (W. C.) & Co., Electrical Engineers, Clydesdale Bank-bldgs, Argyle-st, Glasgow. (*Motive Glasgow*)

Martin, W. W., Manufacturing Electrician, Worcester Cross, Kidderminster

Marwood, A., Electrician, 2, Catherington Villas, Campbell-rd, Southsea, Hants

Mason (D.) & Sons, Driving Band Makers, 12 and 14, Bath-row, Holloway Head, Birmingham. (*Saddlery Birmingham, 864*)

Mason (Joseph) & Co, Electrical and General Automatic Machine Makers, 23, Commercial-rd (City end), London, E.

Mason Science College, Birmingham. (*68.*) (*For list of Professors, see page 270*)

Mason, W. F., Limited, Civil, Electrical, and Mechanical Engineers, 504, Stockport rd, Longsight, Manchester. (*Mason Longsight*)

Mason, R. G., Manufacturer of Electrical Instruments, 69, Park-rd, Clapham, London, S.W.

Massé (Francis) & Co, Makers of Engine Grease and Grease Lubricators, 53, Union-rd, Rotherhithe, London, S.E.

*Massey, W. H., M.I.E.E., M.Inst.C.E., &c. Twyford, Berks; Buckingham Palace, and 25, Queen Anne's-gate, London, S.W. (*Massive London*)

Massingham, H. G., Consulting Electrical Engineer, Bridge-st, Taunton; and at Bath, and Exeter

Mather Brothers, Makers of Electric Light Fittings, 73, Farringdon-st, E.C., and 278, Caledonian rd, N. (*7704*), London

Mather (G. R.) & Son, Steam Engine Makers, Wellingborough. (*Mather Wellingborough*)

Mather, Hugh, Electrical Light Engineer, 13, Brownlow-st, Holborn, London, W.C.

MATHER & PLATT, Limited, Manufacturing Electrical, Mechanical, General and Hydraulic Engineers, Contractors for Electric Light and Power Plants, Electric Railways and Tramways, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. (*Mather Manchester, 556*; *Bahmetal London 3161*)

See also page 291.

Mather, Richard, Maker of Telegraph Vices, Tools, &c., Pond-st, Sheffield

Mather, T., Consulting Electrician, City and Guilds of London Institute, Exhibition-rd, S.W., and 1, Solent-crescent, West Hampstead, N.W., London

Matheson, Ewing, M.I.C.E., Consulting Engineer, 13, Walbrook, London, E.C. (*Matheson Walbrook London*)

Mathieson (Alex.) & Sons, Limited, Tool Manufacturers, Saracen Tool Works, East Campbell-st, Glasgow. (*Mathieson Glasgow, 628*)

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Matson, Jesse, Electrician, 10, Church-ter, Church-rd, Willesden, London, N.W.

Matthews, A., Electrical and Telephone Engineer and Bell Manufacturer, 29, Nine Elms-lane, London, S.W.

MATTHEWS & CO., Electrical and Telephone Engineers, Oxendon-st, Leicester

Matthews & Co, Instrument Engravers, &c., 19, Castle-st East, Oxford-st, London, W.

Matthews, J., General Engineer and Millwright, 91 and 93, Northumberland-st, Liverpool. (*Millwright Liverpool*)

Matthews (Samuel) & Son, India Rubber Manufacturers, 58, Charing-cross, London, S.W.

Matthews, Thomas, M.I.C.E., Engineer, Trinity House, London, E.C.

Matthews & Yates, Limited, Electric Light Engineers and Contractors, 94A, Gray's Inn-rd, London, W.C.; Swinton, and 42, Long Millgate, Manchester. (*Cyclone Manchester*)

Mattinson, J., Electrician and Maker of Private Telephones, 79, Latham-st, Liverpool

Matton, Julius, Maker of the Liégeoise Safety Lamp, 7, St. Mary-axe, London, E.C. (*Matton London*)

Maud & Turner, Machine Tool Manufacturers, Gibbet-st, Halifax, Yorks. (*Maud Turner Halifax, 67*)

Maudslay, Sons & Field, Limited, Steam Engine Makers, 110, Westminster Bridge-rd, 5, Belvedere-rd, and East Greenwich, London, S.E. (*Maudslay London, 4681*)

Maund (A.) & Co, Electric Light Engineers and Contractors, South Molton-st, London, W.

*Mavor, Alfred E., Electrical Engineer (General Manager Fowler-Waring Cables Company, Ltd.), North Woolwich, London, E. (*5091*)

Mavor & Coulson, Engineers and Electricians, 57, West Nile-st, and (Works) 6-16, Orr-st, Bridgeton, Glasgow. (*Prodigious Glasgow, 1369*)

Mavor, H. A., Consulting Electrician, 57, West Nile-st, Glasgow

Mavor, Sam., Electrical Engineer, 57, West Nile-st, Glasgow

Mawson & Swan, Electrical Apparatus Manufacturers, 33, Soho-sq, London, W., and 33, Moseley-st, Newcastle-on-Tyne. (*Manas Newcastle*)

Maxfield, W. B., Registered Patent Agent, 19, Bowling Green-st, Leicester

Maxwell, David, Electrical Engineer, East Dock-st, Dundee

Maxwell (James) & Son, Electrical and Mechanical Engineers, King's-rd, Dundee

Maxwell, Ross & Co, Manufacturing Electrical Engineers, Britannic Works, Bradmore-lane, King-st, Hammersmith, London, W.

*Maxim, Hiram S., Electrician, Baldwyn's-pk, Bexley, Kent

May & Baker, Limited, Manufacturing Chemists, Garden Wharf, Church-rd, Battersea, London, S.W. (*Bismuth London, 9003*)

May, John, Electrician, 2, The Crescent, Richmond, Surrey

May, Roberts & Co, Chemical Glass and Apparatus Manufacturers, 9, Clerkenwell-rd, London, E.C. (*Feeding Bottle London*)

Maybury & Co, Electrical Engineers and Contractors, Lancelot's Hey, Liverpool

Maycock, W. Perren, M.I.E.E., Consulting Electrician and Electrical Engineer 26, Stafford-rd, Croydon, Surrey

Mayer, H., Agent for the Supply of Globes for Electric Lamps, Carbon Rods, &c, 28 to 30, Paternoster-row, London, E.C.

Mayer, John, Electrician, Cathhin-rd, Longside, Glasgow

Mayfield & Co, Manufacturing Electricians 41, Queen Victoria-st, London, E.C. (*Maichamp London*)

Meadowhurst, B., Electrical Engineer, Woodside-lane, North Finchley, London, N.

Meadows (C.) & Co, Limited, Steel Manufacturers, Alliance Forge and Rolling Mills, Tinsley Park-rd, Attercliffe, Sheffield. (C. Meadows, Managing Director) (*Meadows Sheffield, 582*)

Measures Bros, Limited, Manufacturers of Iron and Steel Joists, 57, Southwark-st, London, S.E. (*Measures London, 4586*)

Mechanical Appliances Company, 63 and 64, New Broad-st, and 49, Great Eastern-st, London, E.C. (*Appliances London*)

Mechanical Engineering Company, Manufacturing Electrical Engineers, 136, Great Saffron-hill, London, E.C.

MEDHURST, F. H., B.Sc., Electrical Engineer, 13, Victoria-st, S.W., and 7, Campden-hill-sq, W., London

Medland, John Brandon, Electrician, 141, High-street, Borough, London, S.E.

Medway, —, Electrical Engineer, Millbrook-rd. Southampton

Meik (Thos.) & Sons, Civil and Consulting Engineers, 16, Victoria-st, Westminster, London, S.W.

Meikle, Andrew W., M.A., Consulting Electrician, 18, Cambridge-st, Glasgow

Meiklereid, David, Consulting Engineer, 9, Gracechurch-st, London, E.C.

Meiter (C. W.) & Co, India Rubber, Gutta Percha and Ebonite Makers, 86 and 87, Gracechurch-st, E.C., and Lea River, E., London

Melhuish (R.) & Sons, Electricians, &c., 84, 85, 86, and 87, Fetter-lane, London, E.C.

Mellier (C.) & Co, Electrical Engineers and Contractors, 48, 49 and 50, Margaret-st, Cavendish-sq, and 57, Wells-st, London, W.

Melling, James, Mechanical Engineer, 9, New Broad-st, London, E.C.

Menden and Schwerte, Wire Manufacturers, 9, New Broad-st, London, E.C.

Mendham, Wm. Phillips, Consulting Electrical Engineer, Western Electrical Works, Bristol

Mensing, L. C. H., Electrical and Scientific Instrument Maker, 89, Worship-st, London, E.C. (*Mensing London*)

Menzies, D. P., Electrical and Ventilating Engineer and Contractor, Weem Works, 30, Bishop-st, Anderston, Glasgow

Menzies (James) & Co, Manufacturers of Wrought Iron Pipes, Phœnix Tube Works, Dalmarnock Bridge, Glasgow; and 6, Lime-st-sq, London, E.C. (*Dalmarnock Glasgow: Dalmarnock London*)

Mercer, Edward, Manufacturer of Nuts and Bolts, Ollins Ironworks, Hollinwood

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Mercier (Maunsell) & Co, Electrical Engineers and Contractors, 5, Deansgate, Manchester. (*Wenham Manchester, 1984*)

Meredith, W. M., Electrical Engineer, c/o J. C. Howell & Co, Limited, New Dock, Llanelly

Merionethshire Electric Lighting, Power, and Appliance Company, Limited, Dolgelly

See also page 291.

Merriman, Will. H., Electrical Engineer, 51, Stockwell-rd, London, S.W.

Merveilleuse Electric Arc Lamp Syndicate, Limited, Makers of the Merveilleuse Arc Lamp, 9, New Broad-st, London, E.C.

See also page 291.

Merryweather & Sons, Limited, Electric Hand Lamp Makers, Greenwich-rd, S.E., and 63, Long-acre, W.C., London (*Merryweather London*)

Merton (H. R.) & Co, Dealers in Aluminium, &c., 2, Metal Exchange-bldgs, Whittington-avenue, London, E.C.; and 39A, New-st, Birmingham. (Agents for the Aluminium Industry Company, Limited, of Neuhausen.) (*Merton London*)

Messenger & Sons, Electric Light Fittings Makers, Birmingham

Messer & Thorpe, Consulting Engineers, 8, Quality-ct, Chancery-lane, W.C., and 54-58, Gedling-st, Dockhead, S.E., London

Meteyard & Haine, Electricians, 43, Archer-st Notting Hill, London, W.

METROPOLITAN ELECTRIC SUPPLY COMPANY, Limited, Winchester House, Old Broad-st, E.C. (*Kilowatt London*), and 17, South-st, Manchester-sq, W. (*Detachment London, 3711*), London. London Stations: Whitehall-ct, Sardinia-st, Lincoln's-inn; Rathbone-pl; South-mews, Manchester-sq; and Amberley-rd, Paddington

Sir J. Pender, G.C.M.G., M.P. Chairman
Lord Kelvin, F.R.S. ... ... } Consulting
Dr. J. Hopkinson ... ... } Electricians
Frank Bailey ... ... Chief Engineer
E. Cunliffe Owen, C.M.G.... Secretary

See also page 291.

Metzger, Gus. F., Electrical Engineer and Manager, City of Bath Electric Light Company's Central Station, Bath

Mewburn, J. C., Chartered Patent Agent, 55 and 56, Chancery-lane, London, W.C. (*Patent London*)

Mewburn, John, District Manager for Potteries District (including Derby), National Telephone Company, Limited, Hanley, Staffs (*National Telephone Hanley, 4a*)

Mexican Gas and Electric Lighting Co, Ltd, 15, Bishopsgate-st Within, London, E.C.

See also page 291.

MEYER, Dr. PAUL, Electrical Instrument Maker, 27, Holzmarktstrasse, Berlin, O.
See Advt. p. 641

Mica Company, Dealers in Mica, 86, Leadenhall-st, London, E.C. (R. McGoune Buchanan, Manager). (*Boulanger London*)

Mica Lubricant Company, Manufacturers of Mica and Asbestos Packing, 63, King-st, South Shields

Middleton Electric Light and Power Company, Electric Light Contractors, Middleton, near Manchester

Middleton, P. C., Electrical Engineer, Messrs. New & Mayne, 12, Palace-chmbrs, 9, Bridge-st, Westminster, London, S.W.

Middleton, Robert, Hydraulic Engineer, Sheepscar Foundry, Leeds; and 9, Fenchurch-avenue, London, E.C. (*Hydraulic Leeds, 214; Intensifier London*)

Middleton, Sam, Electrician, 65, Southampton-st, Camberwell, London, S.E.

Middleton, V. G., Electrical Engineer, Princes-mansions, 68, Victoria-st, London, S.W. (*Blancmange London, 3077*)

Midgley, George Henry, Chief Superintendent of Telegraphs, Post Office, Glasgow

Midland Electricity Company, Electrical Engineers and Contractors, 75, Station-rd, Birmingham

Midland Electric Light and Power Company, Limited, Electric Light Engineers and Contractors, 4, New Bartholomew-st, Birmingham; and Central Station, Wise-st, Leamington Spa. (F. W. E. Jones, Resident Engineer)

See also page 291.

Midland Electric Wire Company, Wire Coverers, Braunstone-gate, Leicester

Midland House-to-House Electricity Company, Limited, c/o Messrs. Baker and Gibson, 39, Bennett's-hill, Birmingham. (A. H. Gibson, Secretary)

See also page 291.

Midland Lighting Company, Limited, Lamp Makers, Belgo Lamp Works, Birmingham, and 71, Queen-st, London, E.C.

Midland Railway Carriage and Wagon Company, Limited, Makers of Tram Cars, Midland Works, Birmingham; Abbey Works, Shrewsbury (*Midland Shrewsbury*); and 5, Laurence Pountney-hill, London, E.C.

MIDLAND WIRE CORDAGE COMPANY, Lightning Conductor and Wire Rope Manufacturers, Vincent-st, Balsall Heath, Birmingham. (*Orchard Birmingham*)

Mildé (Ch.) & Co. (Representative in England, M. Kotyra), Telephone Manufacturers, 60, Watling-st, London, E.C.

Millar (A.) & Co, Electrical Apparatus Manufacturers, 45, Montrose-st, Glasgow

Millar, C. H., Electrical Engineer, 15, College-st, Belfast

Millar, Harry, Electrician, 14, Deansgate, Manchester. (*Harry Millar Manchester, 865*)

Miller & Co, Mechanical and Electrical Engineers, London Road Foundry, Edinburgh.

Miller, E. H., Inspector of Risks, Westminster Fire Office, 27, King-st, Covent Garden, London, W.C.

Miller, Francis, B.A., Electrical and General Engineer, c/o Mr. Guy Fricker, 46, Queen Victoria-st, E.C.; and St. Margaret's, Greencroft-gdns, West Hampstead, N.W., London

Miller, H. W., Electrical Engineer, Central Station, 148, Brompton-rd, and 2, York-mansions, Earl's Court, London, S.W.

Miller (I.) & Co, Gauge Makers, 124 and 126, Commercial-st, London, E.

Miller & Johnson, Sulphuric Acid Manufacturers, 30, Mark-lane, London, E.C. (*Fertility London, 2101*)

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Miller, Leslie B., Electrician, 2, Gray's Inn-rd, W.C., and 32, Belmont-rd, West-green, Tottenham, N., London,

Miller, Richard, Electrical Engineer, 54, St. Enoch-sq, Glasgow

Miller, S., Electrician, 1, Langton Cottages, Melbourne-sq, Brixton, London, S.W.

Miller & Sons, Electric Light Engineers and Contractors, 178 and 179, Piccadilly, London, W.

Miller, Thomas L., M.I.Mech.E., M.I.E.E., &c., Consulting and Electrical Engineer, 7, Tower-bldgs, Water-st, Liverpool.

Miller, W., Electrician and Maker of the "Ernst" Storage Battery, 83, Park-end, Bromley, Kent

Miller & Woods, Electrical Engineers, 2, Gray's Inn-rd, Holborn, London, W.C.

Millett, H. C., Electrician, St. Catherine's Lighthouse, Niton, I.W.

Milligan, Thomas, Electrical Engineer, 45, Jocelyn-st, Peckham, London, S.E.

Mills, A. E., M.A., Electrician, 72, Upper Tollington-pk, London, N.

Mills, Arthur, Electrician, 62, Great Percy-st, Amwell-st, London, E.C.

Mills, Edmund J., D.Sc., Electrician and Professor of Technical Chemistry, Glasgow and West of Scotland Technical College, Glasgow

Mills, F. W., Electrician, 2, Fulham Park-gdns, Fulham, London, S.W.

Mills (John) & Son, Electricians and Telegraph Engineers, Walkergate Brass Works (*426 P.O.*), and 23, Collingwood-st (*1075 Nat. and 409 P.O.*), Newcastle-on-Tyne. (*Mills Newcastle-on-Tyne*)

Mills, P. B., Electrician, Waterhouse Electrical Manufacturing Company, 67, Southwark Bridge rd, London, S.E.

Mills Patent Sectional Boiler Company, Limited (Sole Licensees: Messrs. R. Hornsby and Sons, Limited), Whittington-st, Pendleton, and 46, Victoria-bldgs, Victoria-st, Manchester. (*Efficiency Manchester, 1776*)

Mills, Walker & Co, Makers of Brass and Glass Electric Light Fittings, Glass Works, Stourbridge, and 19, Charterhouse-st, London, E.C. (*Mills Walker Wordesley*)

Milne, L., Electrical Engineer, Messrs. J. G. Statter & Co, 68, Victoria-st, London, S.W.

Milne, J., Electrical and General Engineer, South Lodge, Aboyne, Aberdeenshire

Milne, Sons & Macfie, Art Metal Workers, 60, Holborn-via, London, E.C.; and Milton House Works, Edinburgh. (*Milne London*; *Milne Edinburgh*)

Milnquarter Chemical Company, The, Manufacturing Chemists, Bonnybridge, Stirlingshire

Mining Journal, Railway and Commercial Gazette (weekly), 18, Finch-lane, and 3, Dorset-bldgs, Salisbury-sq, London, E.C. (*Fretwork London*) (Price 6d.)

Minns (Sidney) & Co, Boiler Fluid Composition Makers, Trafalgar-rd, and (Works) Livermere-rd, Dalston, N.E. (*Minns London*)

Mitchell, G., Electrical Engineer, 47, Victoria-st, London, S.W.

Mitchell, H. E., Electrician, 8, Nassington-rd, Hampstead, London, N.W.

Mitchell (J. & Co.), Engineers, 95, Drury-lane, London, W.C.

Mitchell (J. Dunlop) & Co, Makers of Globes, Shades, &c., Corn Exchange-bldgs, Hope-st, Glasgow

Mitchell (W. G.) & Co, Electric Bell Fitters, Stokes Croft, Bristol

Mitchell, W., Electrical Engineer, Saltley Works, Birmingham

Mittelhausen, Julius, Electrical Engineer, 28, Wood-st, Woolwich, Kent

Moenich (Oscar) & Co, Telegraph Wire Manufacturers, 8, Coleman-st, London, E.C. (*Moenich London, 94*)

Moffitt, F. J., B.A., Electrician, 42, St. Julian's-rd, Kilburn, London, N.W.

Moir, James, Electrical Engineer, Glasgow Athenæum, St. George's-pl, Glasgow

Moir, William, A.I.E.E., Resident Engineer, Callender's Bitumen, Telegraph and Waterproof Company, Limited, Victoria-bldgs, Albert-st, Birmingham

Mole (M.) & Son, Metal Spinners, Makers of Switch Covers, &c., Stamping and Piercing Works, 51-54, Charlotte-street, Birmingham

Moll, F. H. L. R., Secretary Indo-European Telegraph Company, 18, Old Broad-st, London, E.C.

Moll, Oscar, Traffic Manager Direct United States Cable Company, Limited, 242, Winchester House, Old Broad-st, London, E.C.

Möller, G. F., Electrical Engineer, 9, Brussels-rd, New Wandsworth, London, S.W.

Monckton, C. C. F., Electrical Engineer, 4, Edith-rd, West Kensington, London, W.

Mond, R. L., Electrician, The Poplars, 20, Avenue-rd, Regent's Park, London, N.W.

Money & Nash, Engineers and Electricians, 19, Palace-gdns-mansions, Notting Hill, London, W.

Money-Kent, J. M. V., Engineer and Electrician, Connaught-mansions, 34, Victoria-st, Westminster, London, S.W. (*Megavolt London, 3125*)

Monkhouse, E. W., Superintendent of Mains, Westminster Electric Supply Corporation, Limited, Eccleston-pl, London, S.W.

Monks, Hall & Co, Limited, Steel and Iron Manufacturers, Warrington; and 70 and 71, Bishopsgate-st Wn., London, E.C. (*Monks Warrington*)

Monson, Philip, C.E., Lighting Engineer, Town Hall, High-st, Kensington, London, W.

Monte Video Gas Company, Limited, 321, Dashwood House, New Broad-st, London, E.C. (A. G. Hounsham, Secretary) (*Delambre London*)

Monte Video Telephone Company, Limited, 321, Dashwood House, New Broad-st, London, E.C. (*Monticle London*) (*See also* AMERICAN DIVISION)

Herbert Ward ... ... Chairman
E. M. Reiss ... ... Secretary

See also page 291.

MOODY BROTHERS, Electrical Engineers, 66 Victoria st, London, S.W. (*Opificer London*)

Moody, H. N., Electrical Engineer, 66, Victoria-st, Westminster, London, S.W.

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Moon, W., Telegraph Engineer, Enniskillen, Ireland

Moor, Cresacre George, Electrical Engineer, 13, Market-st, Penistone

Moor & Sons, Manufacturers of Electric Cranes, 1, Fennel-st, Corporation-st, Manchester

Moore, Cuthbert, Electrician, P. & O. steamship "Ganges," c/o P. & O. Steam Navigation Company, Leadenhall-st, London, E.C.

Moore (E.) & Co, Flint Glass Manufacturers, Tyne Flint Glass Works, South Shields; and 30, Holborn, London, E.C. (John A. Leslie, Agent)

Moore, G. Arbuthnot, Electrical Engineer, The Thorns, Bebington, Cheshire

Moore, James, Electrical Engineer, Bolton (Agent for Messrs. C. A. Parsons & Co.)

Moore, John S., Dealer in Electrical, Chemical, and Scientific Apparatus, 56, Grange-rd, Bermondsey, London, S.E.

Moore, Robert, Electric Bell Fitter, &c., 51, Park-st, Patricroft, near Manchester

Moore, W. H., Scientific Instrument Case Maker, 10, Milner-sq, London, N.

Moorhouse, E., District Superintendent of the Edison and Swan United Electric Light Company, Limited, 127, Albion-st, Leeds

Mordan (Francis) & Co, Sealing Wax Manufacturers and Iridium Merchants, 326, City-rd, London, E.C. (*Gums London*)

Mordey, Geo., Electrician and Electrical Engineer, 24, Elliott-rd, North Brixton, London, S.W.

*Mordey, W. M., Chief Electrician to the Brush Electrical Engineering Company, Limited, Belvedere-rd, Lambeth, S.E. (*c/o Magneto London, 4564*), and 34, Montserrat-rd, Putney, S.W. (*Mordey Putney*), London

More (James) & Co, Electrical and Scientific Instrument Makers, 77, Renfield-street, Glasgow

Morecambe Electric Light and Power Company, Limited, 18, The Crescent, and Union-st, Morecambe

Andrews & Preece, Limited ... Engineers
J. Jowett ... ... Secretary

See also page 202.

Moreton & Foster, Telegraph Pole Manufacturers, St. Leonard's Ironworks, 135, St. Leonard-st, Bromley-by-Bow, London, E.

Morgan, Charles Amiss, Telegraph Engineer, General Post Office, London, E.C.

Morgan Crucible Company, Limited, Plumbago and Crucible Makers, Battersea Works, London, S.W. (*Crucible London, 9002*)

Morgan, Mrs. E., Glass Blower for Electrical Purposes, 19, Sekforde-st, Clerkenwell, London, E.C.

Morgan, F., Telegraph Engineer, Central Telegraph Office, St Martin's-le-Grand, London, E.C.

Morgan, Major Joseph B., A.I.C.E., M.I.E.E., Electrical Engineer, Stand House, Childwall, Liverpool

Morgan, W., Electrical Engineer-in-Charge, Drury Lane Theatre, Drury-lane, London, W.C.

MORGAN WILLIAMS & KING, Consulting Electrical Engineers, 39, Victoria st, London, S.W. (*Consonance London, 3059*)

Morgan (W.) & Son, Plumbago Importers, 9, Upper East Smithfield, London, E.

Moritz, George, Limited, Electrical Engineers, 40A, Lancaster-av., Fenwell-st, Manchester.

Morley Memorial College, Royal Victoria Hall, 131, Waterloo Bridge-rd, London, S.E. (Miss C. A. Martineau, Principal, *pro tem.*)

Morris, A., Electrical Engineer, Howden, Yorks.

Morris Brothers, Limited, Electricians and General Scientific Apparatus Makers, Great Hampton-st, Birmingham

Morris, F. Sanders, Consulting Engineer, 22, Buckingham-st, Strand, London, W.C.

Morris & Gold, Lightning Conductor Manufacturers, Wardrobe-chmbrs, Queen Victoria-st, London, E.C. (*Acclivities London*)

Morris, James F. W., Electrician, Lancaster Foundry, Lancaster-st, Borough-rd, London, S.E.

Morris (John) & Sons, Engineers, Salford Fire Engine Works, Manchester (*Fireman Manchester, 1635*)

Morrison (James) & Co, Merchants and Dealers in Electrical Apparatus, 4, Fenchurch-st, London, E.C. (*Manifesto London*)

Morrison, Lieut. G., Telegraph Engineer, Postal Telegraphs, Leicester-sq, London, W.C.

Morrison, Stanley & Co, India Rubber and Asbestos Manufacturers, 24, Duke-st, Aldgate, London, E.C. (*Asbestiform London*)

Morse, Sydney, M.I.E.E., Solicitor and Legal Expert, 4, Fenchurch-avenue, London, E.C., and Lawn House, High Barnet. (*Esrom London, 4062*)

Morton (Francis) & Co, Limited, Telegraph Pole Makers (Iron), Indian Government pattern, 17, Victoria-st, S.W; 110, Cannon-st, E.C., London; and Hamilton Iron Works, Garston, near Liverpool. (*Dropper London; Ironsides Liverpool*)

Morton & Co, Electrical Engineers and Contractors, 9, Scale-lane, Hull

Morton, W., Electrical Engineer and Electric Light Contractor, 127, Sankey-st, Warrington.

MOSELEY (DAVID) & SONS, India Rubber, Gutta Percha, Vulcanite, Ebonite and Fibre Manufacturers, Chapel Field Works, Ardwick, Manchester; 14, Aldermanbury-avenue, London, E.C.; and Glasgow, Paris, Brussels and Hamburg. (*Moseleys Manchester; Moseleys London, 353; Moseleys Glasgow.*) **See Advt. facing Preface, p. 56**

Moseley, Geo., Electrician, 23, Eden-st, Kingston-on-Thames

Moseley, Walker, Electric Bell and Telephone Maker and Fitter, 103, King's-rd, Peckham, London, S.W.

Moser (Ludwig) & Sons, Makers of Electric Light Fittings, Shades, &c., 31, Ely-pl, Holborn Circus, London, E.C.

Moser & Sons, Makers of Soft Charcoal Iron for Electrical Purposes, 178, 182 & 192, Borough High-st, London, S.E. (*Moserson London, 4563*)

MOSSES & MITCHELL Sole Agents for Vulcanised Fibre and the Insulating Saddle Staple, 68 to 71, Chiswell-st, London, E.C. (*Insulator London.*) **See Advts., pp. 578 and 616**

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Moss, W., Engineer and Electrician, 9, Station-rd, Redhill, Surrey

Moston Malleable Castings Company (Limited), Manufacturers of Dynamo Castings, Moston, Newton Heath, Manchester

Mostyn, R. J. F., Electrician, Clarendon House, Dartmouth

Motor Gas Plant Syndicate, Gas Producer Makers, 95 and 97, Finsbury-pavement, London, E.C. (*Igniferous London, 630*)

Mott, Basil, Engineer, City and South London Railway Company, Limited, Stockwell, London, S.W.

*Moulton, J. Fletcher, F.R.S., Q.C., 11, King's Bench-walk, Temple, E.C., and 57, Onslow-sq, S.W., London. (*2609*)

Mountain, A. B., Borough Electrical Engineer, Gas Works-st, Huddersfield

*Mountain, Wm. Chas. (Ernest Scott & Mountain, Limited), Close Works, Newcastle-on-Tyne

Mountstephen, J. T., Electrical Engineer, Electric Light Works, Killarney, County Kerry, Ireland.

Muckle, P., Engineer and Electrician, 2, Bowles-pl, Whetstone, London, N.

MUDFORD'S ARROW ELECTRICAL WORKS, Jackson road, Holloway, London, N.

Mudford, F. J., Electrical Engineer, Arrow Electrical Works, Jackson-rd, Holloway, London, N.

Muir, J. A., Electrician, 22, Woodlands-ter, Charlton, London, S.E.

Muir (Wm.) & Co Manchester), Limited, Machine Tool Manufacturers, Sherbourne-st, Manchester. (Alfred Muir, Managing Director) (*Britannia Manchester, 529*)

Muirhead, A. E., Telephone Engineer and Contractor, 19, Howard-st, and Cart Forge, Glasgow

Muirhead, Dr. A., F.C.S., Consulting Telegraph Engineer, Laboratory, 58, Cowley-st, and 2, Princes-st. Great George-st, Westminster, London, S.W. (*Muirheads London*)

MUIRHEAD & CO, Telegraph Engineers and Manufacturers, 2, Princes-st, Great George-st, and (Works) Storey's-gate, Westminster, London, S.W. Show Rooms: 2, Princes-st, Great George-st, S.W., and 23, Market-st, Nottingham. (*Muirheads London*) **See Advt., p. 521**

Muirhead, John, Electrical Engineer, 23, Regency-st, Westminster, London, S.W.

Muirhead, J., Forge Master, Cart Forge, Crossmyloof, Glasgow. (*Muirhead Glasgow, 1451*)

Mulholland, Maugham & Co, Limited, Mechanical and Electrical Engineers, West Coniforth, R.S.O., Ferryhill, Durham

See also page 292.

Müller, C. A., Agent for Schuckert & Co, 6, Mornington-villas, Bradford. (*Volta Bradford*)

Müller & Co, Wire Manufacturers, 21, Mincing lane, London, E.C. (*Rogers London*)

Mundella, V. A., Lecturer on Electricity and Magnetism, Durham College of Science, Newcastle-on-Tyne

Mundy, George, Electrician, Hawley-cres, Camden Town, London, N.W.

Municipal Electric Light and Power Corporation, Limited, 33, Old Broad-st, London, E.C. (Alfred Aylard, Secretary)

See also page 292.

Munkhouse, E. W., Electrical Engineer, Westminster Electric Supply Company, Limited, Central Station, Eccleston-pl, London, S.W.

Munro, H. D., Electrical Engineer, Exeter Electric Light Co's Central Station, New North-rd, Exeter

*Munro, John, Consulting Electrician, &c., 23, Duppas Hill-ter, Croydon, Surrey

*Munro, John M. M., Electrical Engineer (Messrs. Anderson & Munro), 136, Bothwell-st, Glasgow.

Munro's Electrical Manufacturing Company, Limited, Manufacturers of Electric Light Fittings and Apparatus, Works, Show-Rooms, and Offices: 9, Holland-pl, Glasgow. (*Electrical Glasgow, 167*)

J. M. M. Munro ... ... Managing Director

See also page 292.

Munro, Robert W., Engineer and Machinist, Granville Works, Granville-pl, King's Cross-rd, London, N. (*Robert Munro London*)

Muntz's Metal Company, Limited, Brass and Copper Tube Manufacturers, &c., French Walls, near Birmingham; and 3, Victoria-st, London, S.W. (*Muntz Birmingham*)

Murgatroyd, J., Electric Organ Builder, Bradford, Yorks

Muriel & Co., Electric Bell Manufacturers, Victoria-st, Rochester

Murphy, Walter, Chief Electrician, c.s. "Electra," c/o Eastern Telegraph Co, Winchester House, Old Broad-st, London, E.C.

Murphy, W. M, Electrical Engineer and Contractor, 1, Talbot-st, Dublin

Murray, Angus, Electrical Engineer, Anderson Foundry, Glasgow

Murray, Chas. W., Consulting Engineer and Naval Architect, Oriental-pl, Southampton. (*Marine Southampton*)

Murray, E. T. Ruthven, City Electrical Engineer, Town House, Aberdeen

Murray, G. R., Agent for the London Electric Wire Company, Limited, 8, Central-chmbrs, 11, Bothwell-st, Glasgow. (*Fylde Glasgow, 4710*)

Murray (R.) & Sons, Electrical Engineers, Glasgow

Murray, T. B., B.Sc., Consulting Electrical Engineer, Heavyside, Biggar, N.B.

Muse, Thos., Electrical Apparatus Maker, 1, South View, Newington, Hull

Musgrave (John) & Sons, Limited, Steam Engine Makers, Globe Ironworks, Bolton, Lancs. (*Musgrave Bolton*)

*Mutual Telephone Company, Limited—*taken over by the* New Telephone Company, Limited (*q.v.*)

Myall, Ambrose, Consulting Engineer and Patent Agent, 2, Lancaster-pl, London, W.C. (*Ipra London*)

Mygind, J., Superintendent Great Northern Telegraph Company, Newcastle

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Naftel, P. H., Electrical Engineer, Liverpool Electric Supply Company, Limited, 15, Highfield-st, Liverpool

NALDER BROS & CO, Electricians, Mechanical and Electrical Engineers, Testing and Scientific Instrument Manufacturers, 16, Red Lion-st, Clerkenwell, London, E.C. (*Secohm London, 6770.*) **See Advt., p. 499**

Resistance Coils, Galvanometers, Condensers, Keys, Micrometers and Measuring Machines, Ammeters, Voltmeters.

Nalder, F. H., Electrical Engineer, 16, Red Lion-st, Clerkenwell, London, E.C.

Nalder, H., Electrical Engineer, 16, Red Lion-st, Clerkenwell, London, E.C.

NALDER & HARRISON, Manufacturing Electricians, Trafalgar House, Great Newport-st, Charing Cross-rd, London, W.C. (*Lucimeters London, 35233*) **See Advt., p. 523**

Napier Bros, Limited, Engineers and Boiler Makers, 100, Hyde-park-street, Glasgow (*Windlass Glasgow, 714*)

Napier (D.) & Sons, Engineers and Makers of Speed Indicators, Vine-st ; and 68, York-rd, Lambeth, London, S.E.

NAPIER (R.) & SONS, Shipbuilders and Engineers, Govan, Glasgow. (Builders of the Cable steamers "Amber," "Electra," "Mirror," "Recorder," &c.) **See Advt., p. 612**

Nash, S. A, Electrician, 28, Tootbill-rd, Loughborough

Nash, W. G., Electrical Instrument Maker, 18, Sekforde-st, Clerkenwell, London, E.C.

Nathan, Frank B., A.M.I.C.E., Consulting Engineer, 11, Queen Victoria-st, London, E.C.

National Company for the Distribution of Electricity by Secondary Generators, Limited, Electric Light Engineers (Owners of the Gaulard-Gibbs Patents), 2, Warwick-st, Regent-st, London, W.

W. D'Oyly... ... ... Chairman
J. E. Pickering ... ... Secretary

See also page 392

NATIONAL TELEPHONE COMPANY, Limited (which incorporates the United Telephone Company, Limited, the Lancashire and Cheshire Telephonic Exchange Company, Limited, the Northern District Telephone Company, Limited, the South of England Telephone Company, Limited, the telephone business of the Sheffield Telephone Exchange and Electric Light Company, Limited, the Western Counties and South Wales Telephone Company, Limited, and the Telephone Company of Ireland, Limited), Oxford-ct, Cannon-st, London, E.C. (*National London*) **See Advt., p. 630**

James Staats Forbes ... ... President
Rt. Hon. Lord Balfour of Burleigh ... ... } Vice-President
Wm. E. L. Gaine ... ... General Manager
Albert Anns ... ... Secretary
Dane Sinclair ... ... Engineer in Chief

(For List of National Telephone Company's Centres and other Statistics, corrected to January, 1894, see pages 228, 229 and 292)

National Electric Supply Company, Limited, 119A, Fishergate, Preston (*National Preston, 83 and 145*)

E. H. Booth ... Chairman
J. H. Tonge ... Engineer and Manager
T. Cross ... ... Secretary

See also page 392

National Society for the Exemption of Machinery from Rating—*now the* Machinery Users' Association (*q.v.*)

Nature (weekly), Bedford-st, Strand, London, W.C. (Price 6d.) (*Physio London*)

Nawell, Fred D., Electrician, 240 & 219, Stretford-rd, Hulme, Manchester

Nayler, John, Manufacturer of Dynamo Belting, 200, High-st, Dudley

Naylor (W. N.) & Co, Electric Light Engineers, 34, Colls-rd, Peckham, London, S.E.

*Neale, J., Telegraph Engineer, North Staffordshire Railway Company, Stoke-on-Trent

Nebel, L., Electrical Engineer, c/o Messrs. Siemens Bros. and Co, Limited, 12, Queen Anne's-gate, London, S.W.; and 65, Mount-st, Old Charlton, Kent.

Neele, C. W., Electrician, The Lawn, Clarendon-rd, Watford

Negretti & Zambra, Electrical and Scientific Apparatus Makers, Holborn-viaduct, London, E.C. (*Negretti London, 6583*)

Nehmer Brothers, Makers of the Crown Dry Battery, 27, Sekforde-st, Clerkenwell, London, E.C.

Neill, George, Electrical Engineer, 57A, South Molton-st, London, W.

NELL, FREDERIC, Hydraulic Engineer, the "VICTOR" Turbine, 16, Mark-lane, London, E.C. (*Turbinatus London*) **See Advt., p. 639**

Nelson, J. P., Resident Engineer, Chelmsford Electric Light Co's Central Station, Arc Works, Chelmsford

Nelson & Sons, Electrical and Scientific Apparatus Makers, Station-rd, Twickenham, S.W.

Nettlefolds, Limited, Iron and Steel Wire Makers, 16, Broad-st, Birmingham ; and 9, Fenchurch-avenue, London, E.C. (*Nettlefolds Birmingham ; Nettlefolds London*)

Nevile, R. H. C., Electrician and Joint Manager of Messrs. Dutton & Co, Limited, Railway Signal Works, Worcester

Neville (Julius G.) & Co, Engineers and Manufacturers of Machine Tools, Liverpool (*Neville Liverpool*)

New British Electrical Installation Contractors, Limited, Electrical Engineers and Contractors, 21, Broad-st, Worcester

See also page 392.

New Electricity Supply Company of Croydon, Limited, 1, High-st, Croydon

(*See also page 392*)

New & Mayne, Electrical and General Engineers, 12, Palace-chambers, 9, Bridge-st, Westminster, London, S.W. Works : Woking, Surrey (*New & Mayne, c/o Falatable London*)

New Panulcillo, Limited, Copper Merchants, 3, Great Winchester-st, London, E.C. (*Panulcillo London*)

Sir J. Pender, G.C.M.G., M.P. Chairman
W. Leigh Hunt ... ... Secretary

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New Telephone Company, Limited, The Telephone Exchange, London-wall, London, E.C.; and 102, Portland-st, Manchester (*Telephraze London, Phonos Manchester*)
A. R. Bennett .. ... General Manager
G. J. Somerville ... ... Manager of Manchester District
W. C. Gould ... ... Secretary
See also page 292.

New York Belting and Packing Company, Limited, India Rubber Manufacturers, 38, Finsbury-pavement, London, E.C. (John C. Wylde, Secretary). (*Outwear London, 1560*). (*See also* AMERICAN DIVISION).

New York Hamburg India Rubber Company, Ebonite and Vulcanite Manufacturers, 8, Coleman-st, London, E.C.

New Zealand Electrical Syndicate, Limited, Battersea Foundry, Battersea, London, S.W.
T. C. Morgan ... ... Secretary
A. I. Suckling-Baron... ... Man. Dir. in New Zealand.
See also page 293.

Newall, H. F., Electrician, Madingley-rise, Cambridge

Newall (R. S.) & Son, Limited, Lightning Conductor Manufacturers, Leadenhall-bldgs, 117, Leadenhall-st, London, E.C., and Washington, Durham

Newbold (Walter) & Co, Engineers and Machine Tool Makers, 1A, Laurence Pountney-hill, London, E C. (*Newbold London, 1992*)

Newcastle and District Electric Lighting Company, Limited, 38, Grainger-st West, Newcastle-on-Tyne
Hon. C. A. Parsons ... Managing Director
James Patterson ... ... Secretary
W. D. Hunter... ... ... Engineer
See also page 293.

Newcastle-upon-Tyne Electric Supply Company, Limited, Pandon Dene, Newcastle-upon-Tyne. (*Supply Newcastle-upon-Tyne, 530*)
R. C. Jackson ... ... Manager
M. Short ... ... Secretary
See also page 293.

Newington, F., Electrical Engineer-in-Charge, Westminster Electric Supply Corporation's Central Electric Lighting Station, Millbank-st, Westminster, London, S.W.

Newington, Priddle & Co, Limited—*in liquidation.*

Newitt, L., A.I.E.E., Electrical Engineer, Sir W. G. Armstrong, Mitchell, & Co, Limited, Elswick Works, Newcastle-on-Tyne

Newman, Geo., jun., Electrician, 110, Fenchurch-st, London, E.C.

Newman & Guardia, Scientific Instrument Makers, 92, Shaftesbury-av, London, W.C. (*Goniometer London*)

NEWTON ELECTRICAL ENGINEERING WORKS, Electrical Engineers, Taunton. (*Arc Taunton*)

Newton, F. M., A.I.C.E., Electrical Engineer, Newton Electrical Engineering Works, Taunton. (*Arc Taunton*)

Newton (F.) & Co, Electrical Instrument Makers, 3, Fleet-st, London, E.C.

Newton & Savage, Electricians, 7, Tysoe-st, Clerkenwell, London, E.C.

Newton & Son, Patent Agents, 6, Breams-bldgs, Chancery-lane, London, E.C. (*Newton London, 2640*)

Niblett, George D., Spelter Merchant, Hertford Wharf, Hertford-road, Kingsland, London, N.

Niblett, J. T., Consulting Electrician, 20, Devonshire-rd, Greenwich, London, S.E.

Nicholl, Geo., Telegraph Engineer, Telegraph Department, Midland Railway, Derby

Nicholls, F. O., Electrical and Mechanical Engineer, 19, Corporation-st, Manchester

Nicholls (T.) & Son, Dealers in Electrical Apparatus, 258, Kingsland-rd, London, N. (*Celluloid London*)

Nicholson (Alex.), & Co, Engineers and Boiler Makers, Crown Point Boiler Works, Glasgow. (*Nicholson Glasgow*)

Nicholson, & Tyler, Electrical and Mechanical Engineers, 5, Crown-court, Cheapside, London, E.C. (*Potential London*)

Nicholson, F. B., Consulting Electrician, 5, Crown-court, Cheapside, London, E.C.

Nickel Company, Nickel Refiners, Erdington, near Birmingham. (H. R. Merton & Co, Agents)

Nickel Plating Company, The, Electro Platers, 13, Greek-st, Soho, London, W. (Chas. R. Farquharson, Manager)

Nickolls (Richard) & Sons, Telephone and Electric Bell Manufacturers and Fitters, Lenthall-rd, Dalston, London, N.E.

Nickolls, W. H., Electrical Engineer and Contractor, 58, Clenton-rd, West Green, and (Works), Colina-road, Tottenham, London, N.

Nickson, C., Superintendent of the Manchester Corporation Gas and Electric Light Department, Town Hall, Manchester. (*Gas Manchester, 484*)

Nicol, John M., Electrician, Roborough, South Devon. (*Nicol Bickleigh, South Devon*)

Nicole (David L. A.) & Co, Perpetual Calendar, Astronomical, Non-Magnetisable and Complicated Watch Manufacturers, 85, St. John's-st-rd, London, E.C.

Nicoll, Henry, Electrical Engineer, 69, Lowndes-sq, London, S.W.

Nielsen, F. C. C., Representative in England and Manager in London of the Great Northern Telegraph Company, 3, St. Helen's-place, Bishopsgate-st Within, London, E.C.

Nisbett, G. H., Electrical Engineer, City of London Electric Lighting Company, Limited, 1 and 2, Great Winchester-st, E.C., and 248, Stanstead-rd, Forest Hill, S.E., London

Nixon, F. A., Electrical Engineer, Central Station, Eccleston-pl, London, S.W.

Noad, J., Electrical Engineer, 4, Gove-villas, East Ham, London, E.

Noad, John S., Electrician, Messrs. J. B. Saunders & Co, Telegraph Engineers, Brecon, South Wales

Noakes (D.) & Son, Manufacturers of Electrical and Scientific Instruments, South London Optical Works, Greenwich, S.E. (*8029*)

Noakes, Thomas A., Electrician, 10, Priory-st, and 3, Cambridge-gdns, Hastings

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Nobel's Explosives Company, Limited, Manufacturers of Electric Fuses and Blasting Apparatus, 149, West George-st, Glasgow; and 220, Winchester House, Old Broad-st, London, E.C.

Noble, William, Telegraph Engineer, Postal Telegraphs, Aberdeen

Nonpareil Electric Syndicate, Limited, 2, Victoria-mansions, Victoria-st, London, S.W.

See also page 293.

Norman, J., Consulting Engineer and Machinery Valuer, 131A, St. Vincent-st, Glasgow (*Norman Glasgow*)

Norman, J., Superintendent Commercial Cable Company, Cardiff

Norris & Henty, Limited, Makers of the Robinson Hot Air Engine, 1A, Abchurch-yard, and 235, Upper Thames-st, London, E.C.

Norris (S. E.) & Co, Leather Driving Band Makers, 56-58, High-st, Shadwell, London, E. (*Vigilos London*)

North British Rubber Company, Limited, Ebonite, Vulcanite, and Soft Rubber Manufacturers, Castle Mills, Edinburgh; and 57, Moorgate-st, London, E.C. (*Weba Edinburgh; Ebwa London, 370*)

NORTH BRITISH WIRE MANUFACTURING COMPANY, 130, Fleet-st, London, E.C., and 71, West Nile-st, Glasgow. (*Weaving Glasgow*). **See Advt. p. 467**

North of England Institute of Mining and Mechanical Engineers, Newcastle-upon-Tyne (*Moneo Newcastle-upon-Tyne, P.O. 436, Nat. 1157*)

A. L. Steavenson ... ... President
M. Walton Brown ... ... Secretary

North Metropolitan Tramways Company, Limited, 101, Finsbury-pavement, London, E.C. (Arthur Godfrey, Secretary)

See also page 293.

North, R., Electrician, Patent Office, Southampton-bldgs, London, W.C.

North & Son, Battery Zinc Makers, 121 and 122, London-rd, Southwark, London, S.E.; and Morden-park, Surrey (*Northwards London*)

North-East Coast Institution of Engineers and Shipbuilders, 4, St. Nicholas'-bldgs, West, Newcastle-upon-Tyne. (*Duckitt Newcastle-on-Tyne, P.O. 604*)

Robert Thompson ... ... President
John Duckitt ... ... Secretary

North-Eastern Telephone Company, Limited—*in liquidation*. (Liquidator: T. D. Challoner, 33, Mosley-st, Newcastle-upon-Tyne)

See also page 293.

Northampton Electric Light and Power Company, Limited, 2, St. Giles's-sq, Northampton. (Montague Browne, Secretary)

See also page 293.

Northcote, Chas. S., Electrician and Manager, Messrs. B. Verity & Sons, 29, Prince's-st, Manchester

Northcroft, W., Wire Worker and Weaver, Flood-st, and 135, King's-rd, Chelsea, London, S.W.

NORTHERN ELECTRIC WIRE COMPANY Insulated Wire and Cable Manufacturers, Sedburgh Mills, Halifax. (*Cables Halifax, 127*

Northern Electrical Company, Electrical Engineers, Bolton, Lancs.

Northern House-to-House Electricity Company, Limited, Victoria-bldgs, 21, Grainger-st West, Newcastle-on-Tyne. (C. Harrison Stanton, Secretary)

See also page 293.

Northern Rubber Company, India Rubber Manufacturers, Victoria Works, Retford, Notts. (*Rubber Retford*)

Northern Society of Electrical Engineers, 102, Portland-st, Manchester (Dr. J. Hopkinson, President; J. Darney, Hon. Sec.) (*For List of Officers for 1894, see page 262*)

Northey, P. W., Secretary and Engineer, Richmond (Surrey) Electric Light and Power Company, Limited, Central Station, Richmond, Surrey

Northumbrian Chemical Company, Limited, Electrical and Chemical Engineers, Newcastle-on-Tyne

Northwood, J. & J., Manufacturers of Electric Shades, Globes, &c., Glass Works, Wordsley, near Stourbridge

Norwich Electricity Company, Ltd, Old Bank of England-chmbrs, Queen-st, Norwich.

Fred. W. Harmer ... ... Chairman
A. J. Clark ... ... Secretary

See also page 293.

Norwich Telephone Company, Norwich

Nott, C. H., Engineer and Electrician, Barrington-st, Tiverton, Devon

Nott (J. E.) & Co., Engineers and Ironfounders, High-st, Brecon, S. Wales (*Nott Brecon*)

Nottingham Electric Light and Power Company, Limited—*in liquidation*. (Walter Griffith, 22, Low-pavement, Nottingham, Liquidator)

See also page 293.

Nottingham Machinists' Company, Limited, Electricians and Engineers, Kensington Works, Ilkeston, Derbyshire

Notting Hill Electric Lighting Company, Limited. Works and Office: Bulmer-pl, High-st, Notting-hill, London, W. (*2484*)

William Crookes, F.R.S ... ... Chairman
R. E. Crompton ... ... Consulting Engineer
J. E. Spagnoletti & Crookes ... Engineers
G. Schulze ... ... Electrician
R. G. Rawkins ... ... Secretary

See also page 293.

Nunn, C. W. & G., Electric Light and Bell Contractors, Hertford

Nunn, Wm. & A., Metal Workers, &c., 173, Shadwell High-st, London, E.

NUSSBAUM, G. A., C.E., Engineer and Electrician (General Agent for the Société Industrielle des Téléphones), 29, Ludgate-hill, London, E.C. (*Etincelle London*)

Nuthall, B., Electrical Engineer, Ivy Side, King's-rd, Kingston-on-Thames.

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Oakley (W. H.) & Co, Scientific Apparatus Makers, 202 and 203, Grange rd, London, S.E. (*Oakleys Grange London*)

Oakshott, A., Telegraph Engineer, Postal Telegraphs, Southampton

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Oates, Herbert C., Electrical Engineer, 55, Compton-rd, Wolverhampton.

*Obach, Dr. Eugene, M.I.E.E., F.I.C., F.C.S. (Messrs Siemens Brothers & Co, Limited), Woolwich, Kent

OBITUARY NOTICES, 1893—*see pp. 66 to 75*

O'Brien, Edmond L, A.I.E.E., Electrical Engineer, Electrical Installation Company, Limited, 66, Victoria-st, and 6, South-st, Thurloe-sq, London, S.W.

O'Brien, John Owden, M.I.M.E., Patent Agent, 6, Bank-st, Exchange, Manchester (*Owden, Manchester, 696*)

O'Brien, W. F., Telegraph Engineer, 98, Cannon-st, London, E.C.

Oddy, Thomas, Electrical Engineer, River-st, Rochdale

Odhams, J. & G., Manufacturing Electricians, 206 and 207, Upper Thames-st, London, E.C. (*Odhams London*)

O'Donnell, J. Patrick, Consulting Engineer, 70 and 71, Palace-chambers, Westminster, London, S.W. (*O'Donnell London, 3059*)

*Offor, George, Managing Director, Crystal Palace District Electric Supply Co, Limited, Springfield Works, Wells-road, Upper Sydenham, London, S.E.

Ogg, F. Wm., Electrician, 162, Claremont-rd, Forest Gate, London, E.

Ogle, Percy John, Consulting Engineer, 4, Bishopsgate-st Within, London, E.C. (*Oglio London, 2463*)

Ogmore Valley Electric Light and Power Supply Company (Limited), 2, Wyndham-villas, Nantymoel, near Bridgend, Glamorganshire

John Williams ... ... Chairman
George Wilson ... ... Consulting Engineer
George Adams ... ... Secretary

See also page 293.

O'Gorman, M. J. P., Electrical Engineer, 14, King-st, Portman-sq, London, W.

O'Keeffe, E. A., B.E., Senior Demonstrator and Lecturer on Electrotechnics, Finsbury Technical College, Leonard-st, Finsbury, London, E.C.

Okes, J. C. R., M.I.M.E., Manufacturer of the "Victoria" Leather Belting, 39, Queen Victoria-st, London, E.C. (*Oaktree London*)

Okonite Company, Limited, Manufacturers of Insulated Wires and Cables, 38, Finsbury-pavement, London, E.C. (C. F. Quicke, Manager). (*See* AMERICAN DIVISION)

See also page 294.

Oldenbourg, Ernest, Electrical Engineer, 60, Watling-st, London, E.C.

Oldroyd, Edwin, Electric Light Contractor, Crown Works, Crown-st, Leeds. (*Edwin Oldroyd Leeds, 241*)

Old Students' Association, Finsbury Technical College, Leonard-st, Finsbury, London, E.C.

Lt. B. Atkinson ... ... President
E. B. Vignoles, 28, Lan- } Hon. Secretary and
hill-rd, London, W. } Hon. Treasurer

Oliver, Jesse, Electrical Engineer, 299, Meanwood-rd, Leeds

Oliver, W. M., Electrical Engineer, Leeds and London Electrical Engineering Company, Limited, Steam Plough Works, Hunslet, Leeds

Olliver, G. H., Electrical Engineer, 17, St. Helen's-pl, London, E.C.

Olrick (Lewis) & Co, Engineers and Boiler Makers, 27, Leadenhall-st, E.C., and 57, Pennyfields, Poplar, E., London (*Olrick London*)

Olsson, Gustaf, Electrical Engineer, 125, Everton-rd, Manchester

Olver, Graham T. W., Electrical Engineer, 33, Montague-place, Russell-sq, London, W.C.

Olver, W. Slade, Electrical Engineer, 33, Montague-place, Russell-sq, London, W.C.

Ommanney, W. E., Electric Light Engineer and Contractor, 185, Victoria-st, London, S.W.

Omnibus and Tramcar Electric Lighting Company, Limited, 18, Eldon-st, London, E.C. (J. G. B. Elliot, Secretary)

Oncken Patent Staveless Barrel Company, Limited, 21, Godliman-st, London, E.C. (*Disruptive London*). (C. Rosselli, Secretary; P. R. Allen, Electrical Engineer)

Oppenheimer, H., Manager of the International Electric Company (Sole Depôt of Mix and Genest, Limited, Berlin), 55, Red Cross-st, London, E.C. (*Genest London*)

Oppenheimer, J., Telegraph Engineer, 52, Brown-st, Manchester. (*Cleone Manchester*)

Oppermann, Carl, Electrical Engineer and Contractor, Maker of the Oppermann "Excelsior" Dynamos, 2, Wynyatt-st, Clerkenwell, London, E.C.

Oram (George) & Son, Scientific Instrument Makers, 19, Wilmington-square, London, E.C.

Orcutt, H. F. L, Representative of Ludwig Loewe & Co, of Berlin, Makers of Machine Tools, 145, Cannon-st, London, E.C. (*Orcutt London*)

Oriental Association, Limited, Electric Light Engineers, 26, New Cavendish-st, London, W. (Sydney Parton, Secretary)

See also page 294.

Oriental Telephone and Electric Company, Limited, 14, Austin-friars, London, E.C. (*Oakenpin London, 1367*)

W. Addison ... ... Chairman
A. B. Chalmers ... ... Secretary

See also page 294.

Orme (J.) & Co, Electrical and Scientific Apparatus Makers, 65, Barbican, London, E.C.

Orme Electric Signal Syndicate, Limited, Electric Signal Makers (Works), 65, Barbican, London, E.C.

See also page 294.

Ormerod (J.) & Sons, Driving Band Makers, Castleton, near Manchester. (*Ormerods Castleton, 95*)

Ormiston (Philip) & Co, Telegraph Wire Manufacturers and Coverers, 25 and 27, Old-st, Goswell-rd, London, E.C. (*Ormiston London*)

Orrock, Robert, Glass Blower, Imperial Glass Bottle Works, Wallis-rd, Hackney Wick, London, E.

Osborn, Henry, Tool Merchant, 9, High-st, Southampton

Osborn (Samuel) & Co, Manufacturers of Steel Castings and Engineers' Tools, Clyde Steel and Iron Works, Sheffield; and 32, Queen Victoria-st, London, E.C. (*Osborn Sheffield*)

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Osborne & Co, Anti-Friction Metal and Bronze Makers, 11, Great Garden-st, Whitechapel, London, E.

OSLER, F. & C., Electric Light Contractors and Electrolier Manufacturers, 230, Broad-st, Birmingham; and 100, Oxford-st, London, W. (*Osler London, 3826*)

Oslon, J., Electrician, 91, St. Paul's-rd, Camden Town, London, N.W.

Osman & Co, Scientific Instrument Makers, 132-134, Commercial-st, London, E.

Oswestry Electric Light and Power Co., Limited, Oswald-rd, Oswestry, Salop

See also page 294.

Otis Elevator Co., Limited, Makers of the Otis Electric Cranes, Lifts, &c., 4, Queen Victoria-st, London, E.C.; and 93, Hope-st, Glasgow. (*Lyndentree London, 1710*)

Otis Steel Company, Limited, Iron and Steel Merchants 20, Threadneedle-st, London, E.C. (L. D. H. Jacobs, Secretary)

Oughterson, A., Electrical Engineer and Representative of Messrs. W. T. Glover & Co., 21, Pillar, Royal Exchange, Manchester

Oulton, Joseph, Electrical Engineer, 232, Otley-rd Bradford, Yorks

Ovens, J. L., Electrician, St. Catherine's Villa, Maple-rd, Surbiton

Overweg, Chas., Spelter Merchant, 9, New Broad-st, London, E.C.

Owen, E. Cunliffe, C.M.G., Secretary Metropolitan Electric Supply Company, Limited, Winchester House, Old Broad-st, London, E.C.

Owen, Edward T., Oil and Gas Engine Maker, 25, Alpha-rd, Millwall, London, E.

Owen (J.) & Sons, Makers of Accumulator Boxes, 67, St. Anne-st, Liverpool (*948*)

Owens College, Manchester. (*For list of Professors, see page 265*)

Owens (S.) & Co, Hydraulic and General Engineers, 22, Tudor-st, Whitefriars, London, E.C. (*Owens London*)

Oxford Electric Company, Limited, 45, Broad-st, Oxford. Works: Osney.

Sir Henry C. Mance, C.I.E. Chairman
J. Hardy McLean ... ... General Manager
H. Eeles ... ... Secretary

See also page 294.

Ozone Syndicate, Limited, Electro-chemists and Electricians, 39, Victoria-st, London, S.W.

— P —

PACIFIC AND EUROPEAN TELEGRAPH COMPANY, Limited, 212, Winchester House, Old Broad-st, London, E.C.

Sir John Pender, G.C.M.G., M.P.... Chairman
W. H. Axworthy... ... ... Secretary

See also page 294.

Pacific Telegraph Company, Limited, 32, Victoria-st, London, S.W.

See also page 294.

Padgham, Thomas Henry, Electrical Engineer, Queen Anne's-mansions, London, S.W.

Page, Charles, Electrical Engineer, 2, Beaufort-gdns, St. John's, London, S.E.

Page, H., Electrical Engineer (Messrs. Sneeton & Page), 63, Queen Victoria-st, London, E.C.

*Page, Major S. Flood, Deputy Chairman of the Edison and Swan United Electric Light Company, and Director of the Swan United Electric Light Company, Limited, 100, Victoria-st, and 102, St. George's-sq, London, S.W.

Page & Miles, Electrical Engineers, 60, Western-rd, and Castle-st, Brighton (*288*)

Paget, C. G., Electrician, 91, London-rd, Croydon

Pailthorpe & Krellwitz, Zinc Merchants, 40 & 41, Upper Thames-st, London, E.C. (*Pailthorpe London*)

Paisley, David, Electrical Engineer, 132, Park-lane, Tottenham, London, N. (*Reisender London*)

Paiste, H. T.—*see* Reyrolle (A.) & Co, *and also* AMERICAN DIVISION

Palgrave, A. G., Electrical Engineer, Speaker's Court, Palace of Westminster, London, S.W.

Palatine Engineering Company, Limited, Makers of the Palatine Gas Engine, 10, Blackstock-st, Liverpool (*Waste London*)

Palmer, C., Electrical Engineer, Ewell-rd, Sutton, Surrey

Palmer & Co., Electricians, Albert-bldgs, 49, Queen Victoria-st, London, E.C.

Palmer (John) & Sons, Electricians, 58, Queen's-rd, Clifton. (*585*)

Palmer, Walter, Electrician, Westfield, Reading

Palmer, William, Electrical Engineer, London and Lancashire Electric and General Engineering Co, Limited, Kingsland Green, Dalston, N.E., and 130, Burdett-rd, Mile End, E., London

Palmers Shipbuilding and Iron Company, Limited, Jarrow and King-st, Quayside, Newcastle. (*Pyx Jarrow*)

Pank (A.) & Son, Electrical Engineers, Bedford-st, St. Andrew's, Norwich

Panulcillo Copper Company, Limited—*in liquidation.* (Liquidators: Sir John Pender, G.C.M.G., M.P., Francis J. Johnston and Frank W. Bond)—*See* New Panulcillo, Ltd

PAPER CUTTING, &c., COMPANY, Limited, Telegraph Paper Tape Makers, 90, Goswell-rd, London, E.C. (*Toilet London*)

Paragon Electric Company, Makers of Arc Lamps, 25, Garlick-hill, London, E.C.

Pardoe, George T., Electrical Engineer, 3, Selborne-pl, Littlehampton

Parfitt, G. J. T. J., Electrical Engineer, Keynsham, Bristol. (*Parfitt Keynsham*)

Parfitt & Son—*see* Western Counties Electric Light and Power Syndicate, Limited

Parker Bros., Electric Bell Fitters, Newton Abbot, Devon

Parker, Charles, Electrician and London and Eastern Counties Representative of the Fowler-Waring Cables Co., Limited, 32, Victoria-st, London, S.W.

Parker, Elwin Thorley, Electrician, New Bridge House, Wolverhampton

Parker, Mark, Consulting Electrical Engineer, Strood, Rochester

*Parker, Thomas, F.R.S.E., M.I.C.E., M.I.M.E., M.I.E.E., Chief Electrician and Works Director of the Electric Construction Company, Limited, New Bridge House, Wolverhampton. (*Electric Wolverhampton, 7034*)

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Parker, W. T., Electrician and Electric Bell Fitter, Rose Cottage, Brook green, Hammersmith, London, W.

Parker, William Consulting Engineer, 108, Fenchurch-st London, E.C.

Parkin, Frederick W., Consulting Engineer, Springfield, Liversedge, Yorks. (*Parkin Hightown Yorks*)

Parkin's Signal Works, Makers of Electric Bells and Signals, Liversedge, Yorks; 59-61, Waterloo-st, Glasgow; and 9, Victoria-st, London, S.W. (Stephen Humble, jun., Export Agent)

Parkinson and Frodsham, Manufacturers of Non-Magnetisable Watches, 35, Royal Exchange, London, E.C.

Parkinson and Son, Electrical Engineers and Contractors, 27, Southampton-row, and 18, Gate-st, W.C., and 11, Gloucester-rd, W., London

Parks, R. W., Electrical Instrument Maker, Terminus-rd, Eastbourne

Parkyn & Peters, Manganese and China Clay Merchants, 32, Queen Victoria-st, London, E.C.; and Royal Restormel Mines, St. Austell, Cornwall. (*Parkyn London*)

Parmiter, Albert, A.I.E.E., Telegraph Engineer, Postal Telegraphs, Worcester

Parnacott, Alfred E., Electrician, The Ferns, Laurel Grove, Penge, London, S.E.

Parnall (William) & Co, Ltd, Engineers and Electricians, Victoria-st and Temple-st, Bristol; 15, Seething-lane, London, E.C.; and at Manchester, &c.

Parr, E. A., Electrician, 2, Penton Villas, Kenninghall, Norfolk

Parr (E. B.) & Co, Engine Pattern and Model Makers, 145, Bermondsey New-rd, London, S.E.

Parr & Gillies, Electrical and Mechanical Engineers, 7, Station-bldgs, Haggerston, London, N.E., and at Buckingham

Parr, John, Electrical Engineer, 23, Market-st, Nottingham

Parrack, W. T., Consulting and Inspecting Engineer, 171, Queen Victoria-st, London, E.C.

Parry, Evan, B.Sc., Electrical Engineer, City of London Electric Lighting Company, Limited, 1 and 2, Great Winchester-st, London, E.C.

Parry, T. Samuel, Electric Light Engineer, Princess-st Works, Chester (*Parry Chester*)

Parsone, E. W., Manager and Secretary, South American Cable Co, Ltd, 106, Cannon-st, London, E.C.

Parsons (C. A.) & Co., Electrical Engineers and Contractors, Heaton Works, Newcastle-on-Tyne: 66, Victoria-st, London, S.W.; and 70, Wellington-st, Glasgow (*Turbo Newcastle, 587*; *Dunamis London, 3156*; *Bladens Glasgow*)

*Parsons, Hon. C. A., Heaton Works, Newcastle-on-Tyne; and Elvaston Hall, Ryton-on-Tyne

Parsons, E. M., Electrician and Telephone Engineer, 10, Paragon-st, Hull

Parsons, Geo. H., Electrician, Oakley House, 137, Southgate-rd, London, N. (*546*)

Parsons, H. C., Electrical Engineer, 3, Ashgrove, Cricklewood, London, N.W.

Parsons, J. Hardy, Electrical Engineer, 87, Hinckley-rd, and Faraday Works, Leicester

Partington, W. K., Electric Light Engineer, 3, Willoughby-pk-rd, Tottenham, London, N.

Partington Advertising Company, Agents for the Electrical Advertising Syndicate, Limited, Victoria Embankment, London, W.C.

Partridge (C. B.) & Sons, Electro-Nickel Platers, &c, The Forward Plating Works, Northwood-st, St. Paul's, Birmingham

Partridge, Gerald W., Electrician, London Electric Supply Corporation, Ltd, 3, Adelphi-ter, Strand, London, W.C.

Pascoe, Grenfell & Sons—*see* Williams, Foster & Co, and Pascoe, Grenfell & Sons, Ltd

Pasley, —, Electrician, Sherborne, Dorset

Pastorelli, Alfred, Gauge Maker, 13, Featherstone-bldgs, London, W.C.

Pastorelli & Rapkin, Glass Blowers, 46, Hatton-gdn, London, E.C. (*Rapkin London*)

Pass (C.) & Son, Metal Merchants, Bristol

Patchell, William Henry, A.M.I.C.E., M.I.E.E., Chief Engineer, Charing Cross and Strand Electricity Supply Corporation, 72, Maiden Lane, Covent Garden, W.C.

PATENT AGENTS, INSTITUTE OF—*see* Chartered Institute of Patent Agents

Patent Axle-Box and Foundry Company, Limited, Manufacturers of Castings, Saltley Central Works, Birmingham; and 61 and 62, Gracechurch-st, London, E.C. (*Beuthers Birmingham*; *Beuthers London*)

Patent Exhaust Steam Injector Company, Limited, General Engineers, 4, St. Ann's-sq, Manchester (*Exhaust Manchester*)

Patent Exploitation Company, Limited, Patent Brokers, 10, Lord-st, Liverpool. (*Patents Liverpool, 1605*)

Patent Heater Condenser Company, Makers of Feed Water Heaters, 16, Gt. George-st, Westminster, London, S.W. (*Heaterite London, 3248*)

Patent Indestructible Gas Engine Ignition Tube Syndicate, Limited, Makers of the Wellington Patent Gas Ignition Tube, 100c, Queen Victoria-st, London, E.C.

PATENTS, DESIGNS, AND TRADE MARKS, INFORMATION RELATING TO —*see pages 77 to 87*

PATENT OFFICE, 25, Southampton-bldgs, Chancery-lane, London, W.C. (The Free Public Library is open from 10 to 10 daily, and contains copies of all Patents from the earliest period, as well as many books and periodicals relating to Electricity and its applications)

Patents, &c., Office for the Sale of Printed Specifications, 38, Cursitor-st, London, E.C. (J. R. Morris, Superintendent)

PATERSON & COOPER, Electric Light, Power, and Telephone Engineers, European Works, Pownall-rd, Dalston, N.E., and 3, Princes-mansions, Victoria-st, S.W., London; 137, West Regent-st, Glasgow; and Maritime-bldgs, Dundee. (*Patella London, 1140.*) **See Advt., p. 39**

Paterson, E. J. (Messrs. Paterson & Cooper), European Works, Pownall-rd, Dalston, N.E.; and 125, Queen's-rd, Brownswood Park, N., London. (*Patella London, 1140*)

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Paterson & Son, Model Makers and Electricians, 26, Woodbridge-st, Clerkenwell, London, E.C.

Paterson, John, Electrician, 9, Grosvenor-st, Colne, Lancs

Paterson, R. E., Engineer and Manager, Cheltenham Gas Light and Coke Company, Gloucester-rd, Cheltenham

Paterson (W.) & Son, Electric Bell Fitters, 83, Pitt-street, and 68, Bishop-st, Glasgow. (*Locksmith Glasgow, 980*)

Pateson, Robert, Electrical Engineer and Consulting Electrician to the Lancashire County Council, 95, James-st South, Preston

Paton, Frederick, Electrical Engineer, Blackburn, Dulwich Wood Park, London, S.E.

Patrick & Son, Electrical Apparatus Makers, 529, King's-rd, Chelsea, London, S.W.

Patrick, J. & T., Electric Light and Telephone Fitters, 46 and 55, Union-rd, Rotherhithe, London, S.E.

Patterson, Alfred Edwin, Electrical Engineer and Maker of Electric Engraving Machines, 65, Galleywall-rd, Rotherhithe, London, S.E.

Patterson & Harford, Electrical Engineers, 49, Moorfields, Liverpool; and at Southport

Patterson, Walter, Telegraph Wire Manufacturer, 32, King's-sq, Goswell-rd, London, E.C.

Patterson, William, Manufacturer of Dynamo Brushes, 5, Carliol-square, Newcastle-upon-Tyne. (*Wirework Newcastle-on-Tyne, P.O. 686*)

Pattison, J., Maker of Globes and Shades for Incandescent Lamps, Pilgrim Glass Works, Montford pl, Upper Kennington-lane, London, S.E.

Pattison, William, Maker of and Dealer in Electrical Goods, High-street, Willington, Durham. (*Pattison Willington Durham*)

Pattman & Grover, Dealers in Electrical Supplies, 78, Goswell-rd, London, E.C.

Paul (M.) & Co, Steam Engine Makers, Dumbarton; and 11, Queen Victoria-st, London, E.C.

PAUL, ROBERT W., Electrician and Scientific Instrument Maker, 44, Hatton-gdn., and Leather-lane, London, E.C. **See Advts., pp. 524 and 641**

*Paxman, J. N. (Messrs. Davey, Paxman & Co., Engineers), Colchester

Paxman, William (Messrs Davey, Paxman & Co, Engineers), Colchester

Payne, Ernest, M.A. (Messrs. Smythe & Payne), Engineer, Albany-bldgs, 39, Victoria-st, London, S.W.; and Hatchlands, Cuckfield, Sussex

Payne, H. J., Electrical and Mechanical Engineer and Scientific Instrument Maker, 1, River View, The Terrace, Barnes, Surrey

Payton, W. J., Electrician, 126, Hungerford-rd, London, N.

Peace, J. B., M.A., Electrician, Emmanuel College, Cambridge

Peake, R. E., Electrical Engineer, c/o Messrs. Clark, Forde and Taylor, 4, Gt. Winchester-st, London, E.C.

Pearce Bros., Dealers in Engineers' Tools and Supplies, 57, Crystal Palace-rd, Dulwich, London, S.E.

Pearce, Geo. Edward, Mathematical Instrument Maker, 22A, New Church-court, Strand, London, W.C.

Pearce, George, Electrician, 162, Clapham-pk-rd, London, S.W.

Pearce, J. E., Electrical Engineer, Galway Electric Company, Newtonsmyth, Galway

Pearce (John) & Co., Electric Light Contractors, 182, West Regent-st, Glasgow

Pearce (Wm.) & Sons, Chemical Manufacturers, 1, Bow Common-lane, London, E. (*5221*)

Pearce, A. E., Maker of Dry Batteries, High-st, Southwold (*Pearce Southwold*)

Pearcey, Walter, Electric Bell Fitter, 36, Camomile-st, E.C., and 273, Upper-st, Islington N., London

Pearson & Knowles Coal and Iron Company, Limited, Manufacturers of Wire Rods, Boilers, and Steam Pumps, Dallam and Bewsey Forges, Warrington; and 61, King William-st, London, E.C. (J. Dodds, Secretary) (*Iron Warrington*)

Pearson, Robert H. & J., Limited, Electric Bell Fitters, &c., 141 and 143, High-st, Notting-hill, Uxbridge-st, and Campden-hill-rd, London, W.

Pease, John, Electrical Engineer, Valley Mills, Apperley Bridge, Yorks

Peattie & Axtell, Electrical Engineers, 1, Gloucester-rd, London, S.W.

Peck, G. S., Electrical Engineer, Scarborough Electric Supply Company, Limited, 102, Westborough, Scarborough

Peckett & Sons, Engineers, Atlas Engine Works, Bristol. (*Peckett Bristol*)

Peddie, Henry James, Electrical Engineer, 22, Partington-place, Edinburgh

Peebles & Co (D. Bruce), Electrical Engineers, Tay Works, Leith. (*Peebles Leith*)

Peerless, C. M, Electric Light and Bell Contractor, 8, Duke-st, Brighton

Peers, Geo. R., Electrical Engineer, 34, Memorial-rd, Walkden, Bolton-le-Moors

Peet (George) & Son, Electric Bell Manufacturers, 4, Rathbone-pl, Liverpool

Pegg, George, Electrician and Electrical Engineer, Bradbury Electrical Works, Bradbury-street, High-street, Kingsland, London, N.

Pegg, R. C., Electrical Engineer and Electrician, Garrick Theatre, Charing Cross-rd, London, W.C.

Pegler, W., Jun, Electrician, The Cross, Pontypool

Peirson & Co, Engineers and Contractors for Constructional Ironwork for Stations, &c., 124, Fenchurch-st, London, E.C. (*Allegretto London*)

Pell, Bennett, Consulting Electrician, 6, Granville-park, Blackheath, London, S.E.

Pellatt (Apsley) & Co, Glass Blowers, 21, Northumberland-avenue, Charing-cross, W.C., 17, St. Bride-st, Ludgate-circus, E.C.; and (Works) Pomeroy-st, Old Kent-rd, S.E., London

Pendock, McTavish & Co, Electrical Engineers and Contractors (acting in co-operation with the Bath Electric Light Works), 9, Old Bond-st, Bath; and (Works) 3, Queen's-lane, Bristol

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*Pender, Sir John, G.C.M.G., M.P., J.P., D.L., Chairman of the Eastern Telegraph Company, the Eastern Extension Telegraph Company, the Eastern and South African Telegraph Company, the Brazilian Submarine Telegraph Company, the West African Telegraph Company, the African Direct Telegraph Company, the Direct United States Cable Company, the Direct Spanish Telegraph Company, the Europe and Azores Telegraph Company, the Globe Telegraph and Trust Company, the Metropolitan Electric Supply Company, a Trustee of the Submarine Cables Trust, &c., &c., Winchester House, Old Broad-st, London, E.C.

Penn (J.) & Sons, Limited, Steam Engine Makers, Greenwich, and Creek-st and Deptford Pier, Deptford, London, S.E.

Penn & Son, General Mechanical and Electrical Engineers, 40, Westbury-st, Wandsworth-rd, London, S.W.

Penn, Wm. C., Consulting Engineer, 12, Delahay-st, London, S.W.

Penney (Alex.) & Co, Electric Railway Contractors, 107, Fenchurch-st, London, E.C. (*Finitimus London*)

Penning, J. R., Electrician and Electrical Engineer, Southsea Laboratory, 14, Norfolk-st, Southsea. (*92*)

Penso, Victor, Scientific Instrument Maker, 55, Hatton-gdn, and 8, 13, and 14, Hatton-yd, London, E.C.

People's Palace Technical Schools, Mile End-rd, London, E. (*3072*)

W. Slingo .. ... } Instructors in Electricity
E. T. Carter ... }

Peover, William, Mathematical Instrument Maker, 27, Leigh-st, Burton-cres, London, W.C.

Pepper, Matthew, Electrician, 45-51, High-st, Dover

Peppercorn Bros, Electricians, 15 to 19, Broadway, Deptford, London, S.E.

Peralta, E. de, Electrician, North View, Central Hill, Upper Norwood, London, S.E.

Percy, C. M., M.E., F.G.S., Consulting Engineer, King-st, Wigan

Periam, Herbert W., Bolt, Nut, Screw and Rivet Maker, Floodgate-st, Birmingham. (*Floodgate Birmingham, 373*)

Perken, Son & Rayment, Electrical and Galvanic Instrument Makers, 99, Hatton-gdn, London, E.C. (*Optimus London*)

Perkin, Dr. W. H., F.R.S., Electrician, Professor of Organic Chemistry, Owen's College, Manchester; and 33, Warwick-gdns, Kensington, London, W.

Perkins, Alfred, Electrical Engineer, Reykjavik, Upper Osbaldeston-rd, Stoke Newington, London, N.

Perkins, J. E. S., Electrical Engineer, Queen-st Iron Works, Peterborough

Perkins, Son & Barrett, Pulley Makers, The Forge, Bradford, Yorks.; and 248, High-st, Borough, London, S.E. (*Forge Bradford, 122; Shafting London, 4898*)

Permanent Enamel Company, Makers of Enamelled Plates and Reflectors, Pelly-rd, Plaistow, London, E.

Perrin, W., Manufacturer of Slate Work for Electrical Purposes, 153, Lower Kennington-lane, Lambeth, London, S.E.

Perrow, W. H., Manufacturing Electrician and Telephone Engineer, 8, King-st, Truro

PERRY & CO, Electric Light Fittings Manufacturers, 17, Grafton-st, Bond-st, London, W. (*Periphery London*) **See Advts., pp. 445, 483, 547 and 598**

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Perry, J., Electrical Engineer Galway Electric Co, Newtownsmyth, Galway, Ireland

*Perry, John, M.E., D.Sc., F.R.S. (Professor of Engineering and Applied Mathematics, Finsbury Technical College, Leonard-st, E.C.), 31, Brunswick-sq, London, W.C.

Perry (John) & Sons, Manufacturing Electricians, Cork

Perry, W. A., M.I.M.E., Manager of the Phosphor Bronze Company's Wire Drawing and Rolling Mills, &c., Bagot-st and Aston-rd, Birmingham. (*Phosphor Birmingham, 22*)

Persico, Capt. A., Italian R.N., Naval Attaché to the Italian Embassy, 17, Redcliffe-sq, South Kensington, London, S.W. (*Persicaria London*)

Peru Telephone Company, Limited, 42, Old Broad-st, London, E.C. Edmund Petley, Acting Secretary

See also page 294

Peschek, J., Electrical Engineer, Palace Theatre, Limited, Cambridge-circus, W.C., and (Consulting Electrician) 42, Wellington-road, Charlton, S.E., London

Petchey, Arthur J., Electrical Engineer (Graham, Petchey & Co), 86A, Ford-rd, Roman-rd, London, E.

Peters, —, Dealer in Electrical Apparatus, 74, Royal-rd, Kennington, London, S.E.

Peters, Philip, Electrical Engineer, 31, Schubert-rd, Putney, London, S.W.

Petley, Edmund, Secretary of the Chili, the Ecuador, and the Peru Telephone Companies, Limited, 42, Old Broad-st, London, E.C.

Petrie & Gardiner, Zinc Merchants, 3 and 4, Lime-st-sq, London, E.C. (*Eirtep London*)

Petroleum Association, 85, Gracechurch-st, London, E.C. (William Fox, F.I.C., Secretary and Chemist.) (*4064*)

Petroleum, Gas Light, Heat, and Motive Power Company, Limited, Petroleum Engine Makers, 155, Fenchurch-st, London, E.C. (J. W. Ward, Secretary)

Petterson, Oscar A., Electrician (Messrs. Siemens Bros & Co), Charlton, Kent

Pfeil & Co, Manganese Merchants, &c, 145 to 149, St. John-st, Clerkenwell, London, E.C. (*Pfeil London, 6626*)

Pfeil, Stedall & Son, Iron Merchants, 3 and 6, Broad-st, Bloomsbury, London, W.C. (*Stedall London, 6649*)

Pfister, Frederick, Aluminium Manufacturer, 15, Fore-st, London, E.C.

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Philipp & Co, Manufacturers of Electric Light Fittings, 49, Farringdon-st, London, E.C.

Phillips, A. F., Consulting Electrical Engineer, 31, Great George-st, Westminster, London, S.W. (*Umberto London*)

Phillips, C. J., Telephone Engineer, National Telephone Company, Limited, 58, London-wall, London, E.C.; and Clifton-rd, Wallington (*9345*)

Phillips, Chas. D., Machinery Merchant, Emlyn Iron Works, Newport, Mon.; and Gloucester. (*Machinery Newport, 18*)

Phillips, H. Fentum, Electrician and Electrical Engineer, Stoke, Guildford. (*Phillips Electrician Guildford*)

Phillips, J. A., Electrical Engineer, 50, Linthorpe-rd, Stamford Hill, London, N.

Phillips, J. W. & C. J., Engineers, 23, College-hill, London, E.C. (Agent for the Bristol Recording Voltmeter). (*Colloquial London*)

Phillips & Leigh, Patent Agents, 22, Southampton-bldgs, London, W.C. (*Rotnevni London, 2791*)

Phillips, R. E., Patent Agent and Expert Engineer, 70-72, Chancery-lane, London, W.C. (*Phicycle London*)

Phillips (Walter) & Cowell (J. R.), Consulting Engineers, 32, Queen's-terrace, Southampton (*Philology Southampton*)

Phillips, Walter, Consulting Engineer, 79, Mark-lane, London, E.C.

Philipps, W. Rees, Electrical Engineer, 98, Victoria-st, London, S.W.

Philosophical Magazine (monthly), Taylor & Francis, Red Lion-ct, Fleet-st, London, E.C. (Price 2s. 6d.)

Philosophical Society of Glasgow, 207, Bath-st, Glasgow

Prof. J. G. M'Kendrick ... ... President
J. Mayer ... ... Secretary

Philosophical Transactions of the Royal Society (irregularly), Burlington House, Piccadilly, London, W.

Phoenix Electric Light and Power Company, Electrical Engineers, Market-pl, Whitehaven

PHŒNIX FIRE OFFICE, 19, Lombard-st, E.C., and 57, Charing-cross, S.W., London. **See Advt., p. 481,** *and* Fire Risk Rules *on pp. 123 to 131*

Phœnix Metal Die and Engineering Company, Limited, Aluminium Manufacturers, 40, Coin-st, Stamford-st, London, S.E.

Phœnix Supply Company, Engineers' Furnishers, 15, Hosier-lane, London, E.C. (*Oilnuts London*)

PHONOPORE COMPANY, Limited Faraday House, Charing-cross-rd, W.C., London, (*Orthite London.*) **See Advt. facing Summary of Electrical Events, p. 60.**

Rt. Hon. Sir M. E. Grant Duff, G.C.S.I., C.I.E. ... ... } Chairman
C. E. Spagnoletti ... ... } Managing Director
Charles Isaac ... ... Secretary

See also page 294.

Photophane Company, Photo-Mechanical Art Printers, Caufield Works, Brockley, London, S.E. (Messrs. Benson and Ward, Proprietors). (*Enophot London*)

PHOSPHOR BRONZE COMPANY, Limited, Phosphor Bronze, Bull's Metals, German Silver, and Patent Silicium Bronze Wire Makers, 87, Sumner-st, Southwark, London, S.E.; Wire and Sheet Mill, Bagot-st, Birmingham; and Etruria, Hanley. (*Phosphor Bronze London, 4557; Phosphor Birmingham.*) **See Advt. facing Classified Section, p. 438**

J. Rock ... ... Chairman
R. Lagerwall ... Secretary and Manager

See also page 294.

Physical Society of Glasgow University, Glasgow. (*Carver University Glasgow, 3002*)

Lord Kelvin, F.R.S. ... Hon. President
James H. Gray, M.A., B.Sc. President
Thos. A. B. Carver, B.Sc., C.E. Secretary

Physical Society of London, Royal College of Science, Exhibition-rd, South Kensington, London, S.W.

Prof. A. W. Rücker, M.A., F.R.S. President
T. H. Blakesley, M.A. ... ... } Hon. Secretaries
H. M. Elder, M.A. ... ... }

Picken, William, Electrical Engineer, 2, Prospect-terrace, Babbicombe, near Torquay

Pickering, J. R., Electrical Engineer, 126, Holmesdale-rd, South Norwood, London, S.E.

Pickstone, M. T., Electrician, 2, Todd-st, Higher Broughton, Salford

Pickup (J. H.) & Co, Limited, Electric Light and Sanitary Engineers, 64, Queen Victoria-st, London, E.C.

Picup & Co, Engineers' Agents, 101, Leadenhall-st, London, E.C.

Pidgeon, W. R., Electrician, 42, Porchester-sq, London, W.

Pierce, Edwin, Electrical Engineer, 19, Station-rd, South Norwood, London, S.E.

Pigg, James, Electrician, 37, Union-terrace, York

Piggott, George E., Electrical Engineer, "The Valley," Bromley, Kent

Piggott (Thomas) & Co, Limited, Electrical and Mechanical Engineers, Atlas Works, Spring Hill, Birmingham; and 14, Gt. St. Thomas Apostle, London, E.C. (*Atlas Birmingham; Intersection London*)

Pike, E. J., Wire Worker, 258, Camberwell-rd, London, S.E.

Pilkington & Co, Patentees and Sole Makers of Acid-Resisting Asphalte, Monument-chmbrs, King William-st, E.C., and at Bermondsey and Deptford, S.E., London. (*Poloncam London*)

Pillischer, Jacob, Electrician and Scientific Instrument Maker, 88, New Bond-st, London, W.

PILSEN ELECTRIC COMPANY, Electrical Engineers, Brooke-street Works, Holborn, London, E.C. (*Pilsen London, 2698*)

Pink, E. G., Electrical Engineer, Electric Light Station, Fleet-st, Dublin, and 4, Claremont-avenue, Kingstown

Pintsch's Patent Lighting Company, Limited 32-34, Clerkenwell-rd, London, E.C. (W. B. Rickman, Managing Director) (*Pintsch London, 6737*)

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Pioneer Electric Carriage Company, Limited, 4, Great Winchester-st, London, E.C. (J. W. Barnard, Secretary)
See also page 294.

Piper, E. Jesse, Electrical Engineer (Messrs. Sharp & Kent), 34, Victoria-st, London, S.W. (*Megavolt London, 3125*)

Pippette, Robert, Electrician, 51, Upper Tulse Hill, Brixton Hill, London, S.W.

PITKIN, J., Electrical and Scientific Instrument and Portable Electric Lamp Maker, 56, Red Lion-street, Clerkenwell, London, E.C. (*Barograph London*) **See Advt., p. 491**

Pitman, Maurice, Electrical Engineer, Messrs. Wm. Curtis & Sons, Middle Abbey-st, Dublin

Pitman (P.) & Co, Turbine Makers, 2, Aubrey-rd, Withington, Manchester

Pizzali, Charles, F., Scientific Instrument Maker, 26, Charles-st., Hatton Garden, London, E.C.

PLANET ELECTRICAL ENGINEERING COMPANY, Limited, (Head offices) 28, Victoria-st, Westminster, S.W. (*3086*), and (Showrooms) 67, Piccadilly, W. (*35076*), London; and 150A, North-street, Brighton. (Claud Scott, Secretary) (*Lustre London*)
See also page 294.

Plank, H. E., Secretary, African Direct Telegraph Company, Limited, Winchester House, Old Broad-st, London, E.C.

Plating Company, Limited, Electro, Nickel, Silver, Copper, and Brass Platers, 34 and 35, Kirby-st, Hatton-gdn, London, E.C. (E. A. Herbert, Secretary)

Platinum Plating Company, Limited, 27, Clement's-lane, London, E.C. (Jas. Cromar, Secretary)

Player, J. E. & H., Makers of Electric Light Fittings for Ships, Bingley Works, Birmingham. (*Baynton Birmingham*)

Player & Retallack, Electrical Manufacturers, 36, Moorgate-st, London, E.C.

Plowright, J., Electric Light Engineer, 27, Railway-rd, Market-st, Lynn

Plowright & Son, Dealers in Electrical Supplies, Swaffham

Plucknett, A., M.I.E.E., Electrician, 22, Warmington-rd, Herne-hill, London, S.E.

Plummer, John, Electrician, Colinton, Midlothian

Plummer, T., Telegraph Engineer, Postal Telegraphs, Cork

Poldi Steel Works, Limited, Manufacturers of Crucible Cast Steels, &c., 12, Prideaux-chmbrs, Change-alley, Sheffield

Polglase & Co, Manufacturing Chemists, Tyne Vale Chemical Works, Skinnerburn-rd, Forth Banks, Newcastle-on-Tyne. (*Polglase Newcastle-on-Tyne*)

Pollard, Frederick, Telegraph Engineer, Submarine Depot, Post Office Telegraphs, Dover

Pollit & Wigzell, Limited, Mechanical Engineers, Bank Foundry, Sowerby Bridge, Halifax

Pollitt, John, Electrician, 43, Lower Mosley-st, Manchester

Pollitt, R. B., A.M.I.C.E., Consulting Engineer, c/o Oscar Guttmann, Dunstan House, Mark-lane, London, E.C.

Polyblank, Charles, Electrical and Mechanical Engineer, 47, Wind-st, Swansea. (*Polyblank Swansea*)

Polytechnic Institution, 307, 309, and 311, Regent-st, London, W. (*Polytechnic London, 3747*)

W. Hibbert, F.I.C. ... ...
G. Cripps ... ...
A. Field ... ...
W. J. Thorrowgood ... ...
} Teachers in Electricity

Henry Spooner, A.M.I.C.E. ... } Director of School of Engineering

*Pomeroy, H., Superintending Engineer Postal Telegraphs, Southern District, Cork. (*Superintending Engineer Cork, 46*)

Pontifex (S.) & Co, Electric Light Engineers and Contractors, 22, Coleman-st, E.C., and 18, Stephen-st, Tottenham Court-rd, W., London

Pontifex & Wood, Limited, Engineers, Brass Manufacturers and Copper Merchants, Derby; and 34, New Bridge-st, London, E.C. (*1981*)

Pontypool Electric Light and Power Company, Limited, Electrical Engineers, Club-chmbrs, Pontypool, Mon.
See also page 295.

Pontypridd Electric Lighting Company, Limited, 40, Mill-st, Pontypridd
See also page 295.

Poole, J., Telephone Engineer, 84, Heywood-st, Moss Side, Manchester.

Poole, T. G., M.I.E.E., Electrical Engineer, 4, Whitbread-rd, Brockley, London, S.E.

POOLE & WHITE, Limited, Electrical and Mechanical Engineers, 58 and 59, Bread-st, London, E.C. (*Platessa London, 1982*) **See Advt., p. 620**

Poore, Graydon, Electrical Engineer, 47, Cannon-st, London, E.C.

Poore (Richard) & Co, Limited, Electrical Engineers, 3, Paul's Bakehouse-court, London, E.C.

Pope, Edwyn L., Engineer, Chelsea Electricity Supply Company, Limited, 91, Manor-st, Chelsea, London, S.W.

Pope, Philip C., Electrical Engineer, Messrs. J. E. Spagnoletti and Crookes, St. James's Hall, Burnley. (*185*)

Pope (W.) & Son, Limited, Engineers and Dynamo Makers, &c., Gotha Iron and Boiler Works, Slough, Bucks; and Broad-street-house, Old Broad-st, London, E.C.

Popham, W. V. M., Electrical Engineer, Westminster-chmbrs, 13, Victoria-st, London, S.W.

Popplewell & Co, Patent Agents, 32, Southampton-buildings, London, W.C. (*Popplewell London*)

Port Beira Pier, Tramway and Telegraph Company, Limited, 55 and 56, Bishopsgate-st, London, E.C. (H. Edwards, Secretary)

Porte, Sykes & Co, Electrical Engineers and Contractors, 61, Dawson-st, Dublin. (*Electricity Dublin, 290*)

Porter, Alfred Ernest, Electrician, 1, Park-rd N., Acton, London, W.

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Porter, Chas. V., Manufacturing Electrician, 30, Warham-rd, Harringay, London, N.

Porter, F. A., Electrician and Agent for Messrs. D. and G. Graham, 13, Queen-st, Belfast

Porter, George, Electrician and Electric Bell Fitter, 23, Cullum-st, London, E.C.

Portheim, Roland S., Electrician, 12, Stationter, Church-lane, Woolwich

Postal Journal (monthly), Organ of the Postal Clerks, 64, Victoria-st, Liverpool. (Price 2d.)

Postal Telegraph Offices, Central Station, St. Martin's-le-Grand, London, E.C. *(For list of Principal Officers, see pp. 254 to 256)*

Postal Telegraph Factory. Head Office: Mountpleasant, London, E.C.

Postal Telegraph Factory, Bovay-pl, Holloway, London, N.

Postal Telegraph Schools, Telegraph-st, Moorgate-st, London, E.C. (L. D. Barclay, Officer in charge)

Poths (H.) & Co, Importers of Chemical Apparatus, Vacuum Tubes, Radiometers, &c., 4, Creechurch-lane, Leadenhall-st, London, E.C. (*Poths London*)

Pott, Arthur H., Electrical Engineer, 81, Cornwall-gdns, Queen's-gate, London, S.W.

Pott, W. H., Electrical Engineer, Representative of Messrs. Crompton & Co, Limited, Liverpool

Potter, Douglas, Electrical Engineer, 112, Chetwynd-road, Dartmouth Park, London, N.W.

Potter (F. W.) & Co, Wire Weavers, Drawers and Workers, and DynamoBrush Makers, Phipp-st, Great Eastern-st, London, E.C. (*Wirework London, 531*)

Potter (T.) & Sons, Limited, Electric Light and General Engineers, 44, South Molton-st, S.W., 361, Oxford-st, W., and West End, Hampstead, N.W., London. (H. A. Potter, Managing Director)

Potter, Thomas M., Electrician, 7, Hanover-pl, Regent's Park, London, N.W.

Potter, William, A.M.I.C.E., Electrical Engineer, Messrs. H. F. Joel & Co, 31, Wilson-st, Finsbury-sq, London, E.C.

Pound (John & Co.). Electrical Engineers, &c., 81-84, Leadenhall-st, London, E.C. (*Pound London, 4278*)

Powditch, (J. R.) & Co, Limited—*in liquidation*. (Edwin Hayes, 107, Cannon-st, London, E.C., Liquidator)

Powell, Charles, Electrical Engineer, Chatham, Rochester and District Electric Light Company, Limited, 22, High-st, Chatham

Powell (James) & Sons, Manufacturing Electricians, 26, Tudor-st, E.C., 22, Alfred-pl, W., and 21, Leinster-ter, W., London

Powell, Samuel, Chemical Glass and Apparatus Maker, 37, Swan-st, Great Dover-st, London, S.E.

Power (F. A.) & Son, Telegraph Wire Manufacturers, Midland Wire Mills, Saltley, Birmingham

*Poynting, J. H., D.Sc., F.R.S. (Professor of Physics, Mason College, Birmingham), 11, St. Augustine's-rd, Edgbaston, Birmingham

Poynton, W. A., Electrical Engineer, 4, Salisbury-rd, Dalston, London, N.E.

Pragnell, E. C., Electric Bell Fitter, 136, Great Dover-st, London, S.E.

Pratt, A. H., Maker of Dynamo Brushes, 37, Devonshire-st, Bloomsbury, London, W.C.

Pratt (F.) & Co, Engineers and Tool Makers, Halifax; and 11, Queen Victoria-st, London, E.C. (*Pratt Halifax, 161; Drillpress London*)

Pratt (James Jerram) & Son, Antimony Refiners, 79, Queen-st, London, E.C.

Pratt (Thomas) & Sons, Art Metal Workers, 22, 23, and 24, Tavistock-st, Covent-gdn, London, W.C.

Preddle, Frederick Thomas. Chief Clerk, Direct Spanish Telegraph Company (Lmtd.), Winchester House, Old Broad-st, E.C.

Preece, A. H., Consulting Electrical Engineer, 39, Victoria-st, London, S.W.

Preece, George E., Consulting Electrician, 7, Norfolk-ter, Moss Side, Manchester

*Preece, W. H., C.B., F.R.S., M.Inst.C.E., Consulting Electrician, Chief Engineer and Electrician to the General Post Office, London, E.C. (*350*); and Gothic Lodge, Wimbledon

Preece, W. L., A.I.E.E., Electrical Engineer, Midland Railway Company, Derby

Preller, Dr. C. S. du Riche, M.A., Electrical Engineer, 18, Margaret-st, Cavendish-sq, London, W.

Prellers Leather Company (Stevens, Pellatt & Co), Driving Band Makers, 57, Lant-st, Southwark, London, S.E. (*Prellers Leather London*)

Special Pliable Treble Bands for driving Dynamos; tested breaking strain, 17,220lbs.

Prentice, Napier, Electrician and Electrical Engineer, 73, Queen Victoria-st, London, E.C., and Stowmarket, Suffolk. (*Dynamone London, Napier Prentice Stowmarket*)

Prescott, George, Electrical Engineer, 9, Merrion row, Dublin

Press Association, Limited, Telegraphic News Agency, 14, New Bridge-st, London, E.C. (E. Robbins, Manager.) (*Press Association London, 2668*)

Pressland, Wm. Thomas, Electrical Engineer, 11, Delahay-st, S.W., and 38, Perran-rd, Tulse Hill, London, S.E.

Prestland, Walter, jun., Electrical Engineer, 122, Douglas-st, Deptford, S.E., and 43, King's-rd, Camden Town, N.W., London

Preston, Thomas, M.A., Professor of Natural Philosophy, University College, Dublin

Preston, G. F. L., District Manager, National Telephone Company, Limited, Commercial-st, Sheffield. (*National Telephone Sheffield*)

Preston, G. W., Clerk to the St. Luke's Vestry, Vestry Hall, 225, City-rd, London, E.C. (*1307*)

Preston, Job (late Cubley & Preston), Electrical Instrument Maker, 4, High st, Sheffield

Pretoria Lighting Company, Limited, 29 and 30, Holborn Viaduct, London, E.C. (A. Moir, Secretary in London) (*6748*)

Price & Belsham, Civil and Mechanical Engineers, 52, Queen Victoria-st, London, E.C. (*Belsham London*)

Price & Co, Electrical Apparatus Makers, 26, Ludgate-hill, London, E.C.

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Price & Co, Electrical Engineers, 36, Exchange-chmbrs, Liverpool (*Concentrator Liverpool*)

Price, Edward, Engineer R.N., Electrician, 39, St. David's-rd, Southsea

Price, H. B., Engineer, Chelmsford Electric Light Company, Meadow-side, Springfield, Chelmsford

Price, Henry Sherley—*see* Sherley-Price, Henry

Price, Hugh, Telegraph Engineer, Engineering Department, Postal Telegraphs, Cardiff

Price, Wm. Arthur, M.A., Electrician, 5, Hardy-rd, Westcombe Park, London, S.E.

PRICE, SONS & CO, Insulator and Battery Jar Manufacturers, The Potteries, Bristol (*Price Bristol*); and 113, Midland-rd, St. Pancras, London, N.W. (*7696*) (Charles D. Barker, Agent.) **See Advt., p. 580**

Price's Patent Candle Company, Limited, Manufacturers of Lubricating Oils, Belmont Works, Battersea, London, S.W., and at Birkenhead and Manchester. (*Belmont London*)

Pridmore, Geo. W., Designer and Expert in Artistic Metal Work, 2, Broad-st-bldgs, Liverpool-st, London, E.C.

Priestley, Arthur, Mechanical Engineer, 10, Stroud-rd, Gloucester

Priestley, William, Machinery Merchant and Agent, Southgate-st, Gloucester. (*Priestley Gloucester*)

Priestman Bros, Limited, Engineers, Makers of the Priestman Oil Engine, Holderness Foundry, Hull, and at London and Glasgow. (*Priestman Hull*)

Prim, W. J., Electrical Engineer, Houses of Parliament, London, S.W.

Prime (T.) & Son, Electro-Platers, 107-111, Ryland-st, Birmingham.

Prince, Henry, Consulting Mechanical Engineer, 3, Victoria-st, London, S.W.

Printing Telegraph and Construction Company of the Agence Havas, Limited, 11 and 12, King William-st, London, E.C. (Theodore J. Ford, Secretary)

See also page 295

Pritchard (James) & Sons, Electrical Engineers, 37, St John-st, Clerkenwell, London, E.C.

Pritchard, O. G., Electrician, 76, Florence-rd, Stroud Green, London, N.

PRITCHETTS & GOLD, Electrical Engineers and Contractors, 31, Soho-sq, London, W. Works: Woolwich

Probert, Isaac, Electrical Engineer, Superintendent of Electric Lighting, General Post Office, St Martin's-le-Grand, and 25, Union-rd, Clapham-rd, S.W., London

PROBERT, W., Manufacturer of Probert's Patent Blow-pipe, Brass, Copper and German Silver Tube Merchant, &c., Whateley-rd, Handsworth, Birmingham. **See Advt., p. 450**

Proceedings of the Royal Society (irregularly), Burlington House, Piccadilly, London, W.

Proctor, C. Faraday, Electrical Engineer, Assistant Manager, Edison and Swan United Electric Light Company, Limited, 2, Bedford-villas, Southbury-rd, Enfield, Middlesex

Proctor, H. Faraday, City Electrical Engineer, Electric Light Station, Temple Back, Bristol

Proctor, W. J., Electrical Engineer, Duke-st, Nuneaton

Projectile Company, Limited, Manufacturers of Solid-drawn Steel Tubes, New-rd, Wandsworth-rd, London, S.W. (*Diepress London*)

Protector Lamp and Lighting Company, Limited, Makers of Miners' Safety Lamps, Eccles

Provis & Co, Electric Light Fittings Manufacturers, The Parade, Acton, Middlesex

Pryce, H. J., Loco. Signal and Telegraph Engineer and Superintendent, North London Railway Company, Bow, London, E.

Pryke, William R., Electrical Engineer, London and Lancashire Electric and General Engineering Company, Limited, Kingsland-green, Dalston, London, N.E.

Pulford, G. C., Maker of Magnetic and Damp Wall Paint, 77, Cannon-st, London, E.C. (*Pulford Cannon-st London*)

Pullen, A. E., Assistant Borough Electrical Engineer, Town Hall, Huddersfield

Pullen, F. A., Iron, Steel and Machinery Merchant, 1, Church-court, Clement's-lane, London, E.C. (*Pullen London*)

Pulling, E. W., B.A., Consulting Electrical Engineer, 3, Princes-mansions, Victoria-st, and 68, Redcliffe-gardns, London, S.W.

Pulsometer Engineering Company, Limited, Makers of the Pulsometer Steam Pump, Hayle Foundry, Wharf, Nine Elms, S.W., and 61 and 63, Queen Victoria-st, E.C., London. (*Pulsometer London, 1872*)

Punnett, Thompson & Co, Galvanisers, 122, Cannon-street, London, E.C. (*Punnett London*)

Purcell & Nobbs, Electric Bell Makers, 87 and 89, Cleveland-street, Fitzroy-square, London, W.

Purnell, J. J., Gas Engineer and Model Maker, 30 and 32, Webber-st, Blackfriars, London, S.E.

Pursell (D.) & Co, Ironfounders, Makers of Castings and Forgings for Electricians, Dalkeith, Midlothian, N.B.

Purvis, G. C., Electrician, 43, Barclay-pl, Edinburgh

Pusser (James) & Co, Electric Bell Fitters, 260, Old Kent-rd, and 233, Low-rd, London, S.E.

Putland, E. E., Electrical Engineer, 13, Buckingham-st, Strand, London, W.C.

Pütz (F. J.) & Co, General Chemical Merchants, 21, Mincing-lane, London, E.C.

Pycraft, A. E., Chief Clerk, Electricity Department, St. Pancras Vestry, London, N.W.

PYKE, HARRIS & CO, Limited, Electrical Engineers, 33 and 34, New Tothill-st, Westminster, London, S.W. (*Among London*)

See also page 295

Pym, Edward B., Electrician, Bar-chmbrs, Scarborough

Pyne, H. S., Electrical Engineer, 24, Highfield-cres, Rockferry, Chester

Pynegar, Henry, Electrical Engineer, 5, Dowgate-hill, London, E.C. (*Pynegar London*)

Pyrites Company, Limited, Metal Founders and Merchants, Cornhill-chmbrs, 63, Cornhill, London, E.C. (F. H. C. Levick, Secretary)

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— Q —

Queen Anne's Mansions Lighting and Heating Company, Limited, 251, Winchester House, Old Broad-st, London, E.C.
W. R. Renshaw ... ... Managing Director
John S. Raworth ... Consulting Engineer
J. A. Kelman ... ... Secretary
See also page 295.

Queensland Smelting Company, Limited, 9 and 10, Tokenhouse-yard, London, E.C.

Quick, James, Electrician, 7, Brookhill-pk, Plumstead, London, S.E.

Quicke, Charles F., M.I.E.E., Electrical Engineer, Okonite Company, Limited, 38, Finsbury-pavement, E.C., and Gladstone House, Gospel Oak, N.W., London.

Quincey Bros, Electricians, 146, Seven Sisters-rd, South Tottenham, London, N.

Quirk, Barton & Co, Manufacturers of Tin and Lead Foil for Electrical Purposes, 9, Gracechurch-st, London, E.C.

Quitmann, Carl, Arc Globe and Incandescent Shade Manufacturer, 17, Jewin-crescent, London, E.C. (*Karlus London*)

Quitmann (Julius) and Co, Wire Drawers, 91, Queen Victoria-st, London, E.C.

— R —

Raaschou (Th.) & Co, Manufacturing Electrical Engineers, 63, Queen Victoria-st, London, E.C. (*Luciferous London*)

Radcliff, William, Electrical and Mechanical Engineer, St. Heliers, Torquay

Radcliffe & Co, Electric Light Engineers, Imperial-arcade, Dale End, Birmingham (*1043*)

Radford, F. W. A., Electrical Engineer, Southernhurst, Croydon

Ragosine & Co, Manufacturers of Lubricating Oils, 7, Idol-lane, Eastcheap, E.C., and Albion Wharf, Bow, E., London. (*Ragosine London, 11244*)

Railway Automatic Electric Light Syndicate, Limited, 37, Walbrook, London, E.C.
J. Cecil Bull ... ... Chairman
John Tourtel ... ... Manager
See also page 295.

Railway Electric Reading Lamp Company, Limited, 37, Walbrook, London, E.C. (A. J. Stuart, Secretary)

RAILWAYS, BRITISH, Principal, with Chief Officials and Telegraph Engineers—*see pages 252 and 253*

Railway Signal Company, Limited, Makers of Electric Signals, Fazakerley, Liverpool; and 16, Eastcheap, London, E.C. (George Edwards, Managing Director)

Railway Telegraph Superintendents' and Engineers' Society. (J. Neale, Stoke-on-Trent Station, N. Staffordshire Railway, Hon. Sec.)

Railway World (monthly), 39, Victoria-st, London, S.W. (Ann. sub. 6s., single copy 6d.)

Rainbow Engineering Company, Limited, Electrical Engineers, Albany-bldgs, 39, Victoria-st, London, S.W.

RAINS, MIDDLETON & CO, Electricians, 34, Victoria-st, London, S.W. (*3125*). **See Advt. p. 574.**

Rait & Gardiner, Engineers, Boiler Makers, and Shipwrights, 155, Fenchurch-st, E.C. (*4091*); and Millwall, Royal Albert, Victoria, and Tilbury Docks, E, London. (*Repairs London*)

Ram, Gilbert S., Electrician, 32, Oakley-sq, London, N.W.

Ramage, Percy A., Electrician (Mather & Platt, Limited), Salford Iron Works, Manchester. (*Ramage c/o Mather Manchester, 556*)

Ramsay (W.) & Co, Electric Light Engineers and Lamp Makers, 254, Argyle-st, and 94, Renfield-st, Glasgow. (*Lamps Glasgow, 3652*)

RAMSDEN, CAMM & CO, Limited, Wire Manufacturers, &c., Brighouse, Yorkshire. (*Ramsden Brighouse, 5*) London Office: 72, King William-st, E.C. **See Advt., p. 10**
Specialities of finest sizes of Copper, German Silver, Phosphor Bronze, Tin Wires, &c., &c.
See also page 295.

Ramshay & Marshall, Iron, Steel, and Metal Merchants, 17, Lime-st, London, E.C. (*Ramshay* Inland, *Exelby* Foreign, *London*)

Rance, John, jun, Superintending Engineer, Bournemouth and District Electric Light Supply Company, Limited, 22, Observer-chambers, and "Cambrai," Alum Chine-rd, Bournemouth. (*Electric Bournemouth*)

Randall, C. A., Electrician, 1, The Avenue, Bedford Park, London, W.

Randall, J., Borough Electrical Engineer, Town Hall, Portsmouth

Randall, J. W., Electrician and Agent, 110, Cannon-st, London, E.C. (*Obversely London*)

Ranken, A. W., Assistant Electrical Engineer, Corporation Central Station, Temple Back, and 21, Clyde-rd, Redland, Bristol

Rankine (John) & Sons, Electrical and Marine Engineers, Corporation Quay, North Shields

Ransome (A.) & Co., Limited, Iron and Brass Founders, Stanley Works, King's-rd, Chelsea, and Battersea Foundry, Wellington-rd, Battersea, London, S.W. (*Ransome London, 8578*)

Ransome & Marshall, Hydraulic and General Engineers, 67, Tithebarn-st, Liverpool. (*Ransome Liverpool, 1658*)

Ransomes & Rapier, Railway Signal Manufacturers, Waterside Ironworks, Ipswich; and 32, Victoria-st, London, S.W. (*Waterside Ipswich; Ransomes Rapier London, 3012*)

Ransomes, Sims & Jefferies, Limited, Makers of Steam Engines for Electric Lighting, &c., 9, Gracechurch-st, London, E.C.; and Orwell Works, Ipswich. (*Anglia London; Ransomes Ipswich*)

Raphael, F. C., Electrical Engineer, Elmstead, Broadhurst-gdns, London, W.

Rashleigh Phipps & Co., Electric Light Engineers and Contractors, 102, Oxford-st, London, W. (*Diffuser London, 3973*)

Ratliffe, G., Consulting Engineer, 7A, Laurence Pountney-hill, London, E.C. (*Forgings London*)

Ratcliff (Joseph) & Sons, Manufacturers of Electric Light Fittings, Birmingham

*Ravenshaw, H. W., A.M.I.C.E., Electrical Engineer, Messrs. W. T. Goolden & Co, Woodfield-rd, Harrow-rd, London, W.

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Rawfolds Wire Company, Wire Drawers, Rawfolds Mills, Cleckheaton, Yorkshire. (*Rawfolds Cleckheaton*)

Rawlings Bros., Electricians and Domestic Engineers, 82, Gloucester-rd, and Lenthall Works, South Kensington, London, S.W. (*8786*)

Rawlings (S.) & Son, Belting Manufacturers, South Parade Works, Frome, and 9, Gracechuach-st, London, E.C.

Rawlings, W. R., Electrician, 82, Gloucester-rd, and 18, Earl's Court-gdns, South Kensington, London, S.W.

Rawlins, T. J. D., Maker of the Revolving Primary Battery, High-st, Lymington, Hants

Rawlins, W., Fire Risks Inspector, Kent Fire Office, 124, Cannon-st, London, E.C.

Raworth, John S., Joint Manager, Brush Electrical Engineering Company, Limited 112, Belvedere-rd, Lambeth, S.E., and 24, Kirkstall-rd, Streatham-hill, S.W., London. (*4564*)

Rawson Bros, Electricians and Wiring Contractors, 143, Edward-st, New Cross, London, S.E.

*Rawson, Frederick L., Electrical and Civil Engineer, 88, Queen Victoria-st, E.C. (*1978*), and 3, Kensington-ct, W. (*8906*), London. (*Woodhouse London*)

*Rawson, W. Stepney, M.A., 88, Queen Victoria-st, E.C. (*1978*), and 86, York-st, Westminster, S.W., London

*Rayleigh, the Right Hon. Lord, Lord-Lieutenant of Essex, M.A., D.C.L., LL.D., Secretary Royal Society, F.R.A.S., F.R.G.S., Consulting Electrician (Professor of Natural Philosophy at the Royal Institution), Terling-pl, Witham, Essex

Rayment, L., Manufacturing Electrician, Cradley, Staffs. (*Rayment Cradley*)

Rayment (Wm.) & Co, Glass Benders, 157, St. John-st, London, E.C.

Rayner & Co, Patent Agents, 37, Chancery-lane, London, W.C.

Rayner, T. H., Electric Light Engineer, Fitzwilliam-st East, Huddersfield

Rea, P. J., Electrical Engineer, Crystal Palace District Electric Light Company, Limited, Springfield Works, Wells-rd, Upper Sydenham, London, S.E.

Read, Campbell & Co., Limited, Electrical Engineers and Contractors, 55, Broad-st-avenue, London, E.C. (*562*)

Read, C. E., Electrical Instrument Maker, 229, Albany-rd, Camberwell, London, S.E.

Read (T.) & Co, Electrical Engineers, Kinder-st, St. George's, London, S.E.

Reading Electric Supply Company, Limited, Blagrave-st, Reading

See also page 295.

Readman, J. B., D.Sc., Electrician, Chemical Laboratory, 4, Lindsay-place, George IV. Bridge, Edinburgh. (*Readman Edinburgh*)

Ready, G. W., Electrical Engineer, Electric Light Department, Royal Courts of Justice, London, W.C.

Reason, Henry, Electrical Instrument Maker, 111, Gloster-rd, Brighton

Reavley, T. W., Electrician, Prospect-ter, Jarrow

Reddall, Wm., Maker of Electric Light Wire Conduits, 10, South-street, Finsbury, London, E.C.

Reddaway (F.) & Co, Limited, Manufacturers of Belting, Cheltenham-st, Pendleton, Manchester; 20, Bucklersbury, London, E.C.; and at Glasgow, Birmingham, Sheffield and Halifax. (*Anchorage Pendleton, 522*)

Redfern (G. F.) & Co, Patent Agents, 4, South-st, Finsbury, London, E.C. (*Invention London, 169*)

Redpath & Paris, Steam Engine Makers, Lea Cut Iron Works, Church-row, Limehouse, London, E.

Redmond, D. D., M.D., Electrician and Consulting Electrical Engineer, 126, Sandford-rd, Dublin

Reed, Alexander Henry, Consulting Engineer, 64, Mark-lane, London, E.C. (*Wagon London*)

Reed, Blight & Co, Limited, Electrical Engineers, 47, Victoria-st, Westminster, London, S.W.; and at Eagle Works, Plymouth (*Bildstein London*)

Reed, Charles, Electric Bell Manufacturer, 65, Cardiff-st, Aberdare

Reed (Chas. H.) & Co, Manufacturers of Special Dynamo Magnets, Trimdon Iron Works, Sunderland. (*Charles Reed Sunderland*)

Reed, George H., Electrical Engineer, The Factory, Chagford

Rees, John Price, Electrician, 23A, New Kent-rd, London, S.E.

Reeve, George, Electrician, 4, Crimscott-st, London, S.E.

Reeves, F. R., Electrical Engineer (Secretary Crompton & Co., Limited), Mansion House-bldgs, Queen Victoria-st, London, E.C.

Reich (S.) & Co, Glass Manufacturers for Electrical Purposes, 25, Finsbury-st, London, E.C.

REID BROS, Telegraph and Electric Light Engineers and Contractors, Pneumatic Signal Manufacturers for the Transmission of Papers, &c., 12, Wharf-rd, City-rd, London, N. **See Advt., p. 14**

Reid, David, Electrical Instrument Maker, 16, 18 and 20, Cambridge-st, Glasgow

Reid (F.) Ferens & Co., Electrical Engineers, 13, Railway Arches, Westgate-rd, Newcastle-on-Tyne

Reid, Hugh, Electrician, Belmont, Springburn, Glasgow

Reid, James, Telegraph Engineer, Glasgow and South-Western Railway Company, St. Enoch Station, Glasgow

Reinold, A. W., M.A., F.R.S., Professor of Physics, Royal Naval College, Greenwich, London, S.E.

Reliance Lubricating Oil Company (H. W. Holt & Sons), Lubricating Oil Manufacturers, 19 & 20, Water-lane, London, E.C.

Rennie, D. B., Electrical Engineer (Messrs. Graham & Morton), King-st, Stirling

Rennie, J., M.I.E.E., Electrical Engineer, 10, Rodney-ter, Lower Richmond-rd, Putney, London, S.W.

Rennie, John, M.I.E.E., Electrician, Board of Trade Electrical Standards Laboratory, 8, Richmond-ter, Whitehall, London, S.W.

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Rennoldson, Thomas Pattison, Electrician, Banbridge, co. Down, Ireland

Renshaw (W. R.) & Co, Electrical Engineers, Queen Anne's-mansions, London, S.W.

Rentell, Sidney, Consulting Electrical Engineer, Auckland House, 17, Harleyford-st, Kennington, S.E., and 29, Ludgate-hill, E.C., London

Renwick, James, Electrical Engineer, 58, Olinda-rd, Stamford-hill, London, N.

Renwick, R. M., Superintendent Eastern Telegraph Company, Limited, 5, Royal Bank-pl, Glasgow

RETTIE, CHARLES, Electrical Engineer and Contractor, 18, Geraint-st, Liverpool (*Lightning Liverpool*)
Speciality: Ship Work and Automatic Fire Alarms.

Reuter's Telegram Company, Limited, Telegraphic News Agency, &c., 24 & 25, Old Jewry, London, E.C. (*Reuter London, 1718*)
Adm. Sir J. C. D. Hay, Bart. Chairman
H. de Reuter .. .. Man. Director
W. F. Bradshaw ... ... Secretary
See also page 295.

Rew, G. H., Electrical Engineer, Pembury, Maberley-rd, Upper Norwood, London, S.E.

Reynolds & Branson, Manufacturers of Electrical Apparatus, 14, Commercial-st, Leeds

Reynolds & Co, Makers of Wire Staples, 57, New Compton-st, London, W.C.

Reynolds, J. H., Director of the Municipal Technical School, Prince's-st, Manchester

Reyrolle (A.) & Co (Agents for H.T. Paiste, Maker of Electrical Supplies, Philadelphia, Pa.), 10, Union-mews, Union-st, Middlesex Hospital, London, W. (*Reyrolle London*) (*See also* Paiste, H. T., *in* AMERICAN DIVISION)

Rheinisch Westfalische Kupferwerke, Brass and Copper Wire Manufacturers, 6, 'Lime-st, London, E.C.

Rhenish Rubber and Celluloid Company, Rubber Manufacturers, 65 & 66, Basinghall-st, London, E.C. (Beutner & Co, Agents). (*Sunclad London, 451*)

Rhodes, A., Electrical and Mechanical Engineer, Providence Foundry, Stanningley, near Leeds

Rhodes Bros, Electrical Apparatus Makers, Hanover Works, Hanover-lane, Leeds

Rice & Co, Hydraulic and General Engineers, Neville Works, Elland-rd, Leeds. (*Press Leeds*)

Richard & Co, Importers of Electric Clocks, Instruments and Apparatus, 24, Cannon-st, London, E.C.

Richards, A. E. G., Electrician, The Admiralty, Pall-mall, London, S.W.

Richards, Thomas Percival, Electrician, 3, Victoria-st, S.W.; and 174, Beckenham-rd, Penge, London, S.E.

Richards, —, Electric Bell Manufacturer, Duke's Town, Tredegar

Richardson, A. E., B.A., F.C.S., Electro-Chemist, Dorking, Surrey.

Richardson, A. J. E., Electrician, 94, Huddleston-rd, Tuffnell-pk, London, N.

Richardson Arc Lamp Company, Makers of the Richardson Arc Lamp, Patricroft, Manchester

Richardson, A. W., Electric Light and General Engineer, Worsley-rd, Patricroft, near Manchester. (*Richardson Engineer Patricroft*)

Richardson, O. A., Fire Risks Inspector, Surveyor's Office, Sun Fire Office, Threadneedle-st, London, E.C.

Richardson, C. D., Manufacturing Electrician, 17, Cross-st, Hatton-gdn, London, E.C.

Richardson (E.) & Co, Electric Bell Manufacturers, 8, South-grove, Highgate, London, N.

Richardson, Ellson & Co, Electric Light Apparatus and Fittings Manufacturers, 17 and 18, Brownlow-st, High Holborn, W.C., and Elm Works, Somers Town, N.W., London

Richardson (Henry G.) & Sons, Glass Globe Manufacturers, Wordesley, Stourbridge; and 13, Thavies-inn, Holborn-circus, London, E.C. (*Richardson Wordesley*)

Richardson (T.) & Sons, General Engineers, Hartlepool. (*Richardsons Hartlepool*)

Richmond (Joseph) & Co., Limited, Electrical Engineers, 30, Kirby-st, Hatton-gdn, E.C., and New Sun Iron Works, 180½, Burdett-rd, Bow, E., London

Richmond, Joshua, Electrical Instrument Maker, 10, Kirby-street, Hatton-garden, London, E.C.

Richmond (Surrey) Electric Light and Power Company, Limited, Central Station, Richmond, Surrey. (P. W. Northey, Secretary and Engineer)
See also page 295.

RICKARD, WM., Electrical Wire Manufacturer, Ashbourne-rd Mills, Derby. (*W. Rickard Derby, 18*)

Riddell, H. G., Electrician and Electric Light Contractor, Cuthbert-bldgs, Clayton-sq, Liverpool

Riddell, J. G., Electrician, 18, King-st, Manchester

Riddell (Wm.) & Co, Wire Drawers, 636, Springfield-rd, Glasgow. (*Riddell Parkhead*)

Riddle, Edward, Electrician, Low Leam, Glenluce-rd, Westcombe Park, London, S.E.

Rideal, Dr. S., F.I.C., F.C.S., Electrician and Electro-Chemist, Bowlhead Green, Thursley, Godalming

Rider, John H., Borough Electrical Engineer, Town Hall, Bolton

Ridley, Herbert W., A.I.E.E., Electrician, 100, Bennerley-rd, Wandsworth-common, London, S.W.

Ridley & Moss-Blundell, Consulting Engineers, 28, Victoria-st, London, S.W.

Rigby (John) & Sons, Bolt and Nut Manufacturers, Wednesbury. (*Rigby Wednesbury*)

Rigg, Arthur, Electrical Engineer, 42, Old Broad-street, London, E.C.

Riley, James, Telegraph Instrument Case Maker, 7, Mercer-st, Long-acre, London, W.C.

Riley, J. S., Dynamo Machine and Electromotor Maker, Riddings, Alfreton, Derbyshire

Riley, Prof. J. T., D.Sc., Professor of Electrical Engineering, Bradford Technical College, Bradford. (*321*)

Rimington, E. C., Electrician, Lynton House, The Park, Norwood, London, S.E.

Rinder & Co, India Rubber Manufacturers, 18, Lyte-st, Cambridge Heath, London, E.

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Rippon, Joseph, General Manager Halifax & Bermudas Cable Company, 33, Old Broad-st, London, E.C.

Risch, C. H. C., jun, Electrical Engineer, Lansdowne-rd, Old Charlton, Kent

Ritchie, John, Consulting Engineer, Messrs. Carrick & Ritchie, Waverley Engineering Works, near Abbey-hill Station, Edinburgh. (*Crane Edinburgh*)

Ritchie, Robert O., Electrical Engineer, Electric Construction Company, Limited, Queen-st Chambers, Queen-st, London, E.C.

Ritson (Thomas) & Co, Electric Light Fittings Manufacturers, Redheugh Bridge-rd, Gateshead

Ritter, J. E., Manager of the Limavady Power and Light Works, Roe Park, Limavady, Ireland

River Plate Electricity Company, Limited, 78, Coleman-st, London, E.C. (*Luciente London.*) (*See also* AMERICAN DIVISION)

J. H. Duncan ... ... Chairman
W. R. Cassels ... ... Managing Director
S. Z. de Ferranti ... Consulting Engineer
Francisco Cassels ... Electrician
T. S. Hamilton ... ... Secretary

See also page 295.

River Plate Telegraph Company, Limited, 188, St. Vincent-st, Glasgow. (*Manuca Glasgow, 1368.*) (*See also* AMERICAN DIVISION)

John Oldham ... ... Manager(MonteVideo)
J. Mann, C.A. ... ... Secretary

See also page 295.

ROBERTS, ADLARD & CO, Makers of Slate Switchboards, &c., 47, Eastcheap, London. (*Dralda London.*) **See Advt., p. 614**

Roberts, E., Electrician, 19, Sterndale-rd, West Kensington, London, W.

Roberts, Frederick, Electrician, 62, Eldon-st, Walsall

Roburite Explosives Company, Limited, Makers of Electric Fuses, &c, 103, Cannon-st, London, E.C.; and (Works) Gathurst, near Wigan

*Roberts-Austen, W. Chandler, F.R.S., F.C.S., Chemist to the Royal Mint, London, E.

Roberts, Martin F., A.M.I.C.E., M.I.E.E., F.C.S., Superintendent Postal Telegraph Factory, Mount Pleasant, E.C., and Madgehill, Hanwell, W., London

Robertson & Co, Electrical Engineers, 9, Old Sneddon-st, Paisley. (*Robertson Sneddon, 2*)

Robertson & Co, Makers of Electrical Specialities, 234, Sauchiehall-st, Glasgow

ROBERTSON, C. J., Engineer and Managing Director, Incandescent Electric Lamp Company, Limited, Brook Green Works, Hammersmith, London, S.W.

Robertson, Dr. John A., Electrician, Stilton, Peterborough

Robertson, Geo. Hy., Electrician, F.C.S., A.I.C. 30, Hemstall-rd, West Hampstead, London, N.W. (*See also* COLONIAL DIVISION).

Robertson, Geo., jun, Electrician, 9, Old Sneddon-st, and 4, New Sneddon-st, Paisley. (*Robertson Sneddon, 2*)

Robertson, H. J., Electrician, Thornloe, Oban, Argyleshire

Robertson (J. W.) & Co, Platinum Dealers, 100, Aldersgate-st, London, E.C.

Robey & Co, Limited, Steam Engine Makers for Electric Lighting, &c., Globe Works, Lincoln; 117, Cannon-st, London, E.C.; and 32, Tower-bldgs, Water-st, Liverpool. (*Robey Lincoln; Robey London, 1505*)

Robinson (A.) & Co, Makers of Ships' Telegraphs, 32, Strand-st, and (Works) Crooked-lane, and 13, Litherland-alley, Liverpool. (*Impermeators Liverpool, 1609*)

Robinson, Alex. Hunter, Electrical Engineer, Oakhill Park, Liverpool

Robinson & Auden, Mechanical Engineers, 47, Victoria-st, London, S.W. (Sole Agent, R. Aylmer). Works: Wantage, Berks. (*Leclanché London*)

Robinson, C. Norman, Electrical Engineer, 37, College-hill, Dublin

Robinson, E. E., Electrician, c/o Dr. O. J. Lodge, University College, Liverpool

Robinson (F. A.) & Co, Engineers, Merchants, and Shippers, 69, Cornhill, London, E.C. (*Farrayo London*)

Robinson, F. L., Secretary West Coast of America Telegraph Company, Limited, 120, Cannon-st, London, E.C.

Robinson, H., Dealer in Electrical Supplies, Ferndale, Kington, Herefordshire

Robinson, Prof. Henry, Consulting Engineer and Electrician to the Vestry of St. Pancras, N.W., and 13, Victoria-st, S.W., London

Robinson (J.) & Co, Electric Wire and Cable-Covering Machine Manufacturers, Springfield-lane Iron Works, Salford, Manchester. (*Opal Manchester, 783*)

Robinson (J.) & Sons, Electrical and Scientific Instrument Makers, 65, Grafton-st, Dublin

Robinson, John L., Chairman Electric Light Committee, Dublin Corporation, Dublin

Robinson, Mark, M.I.C.E., M.I.E.E., M.I.N.A., Chairman of Willans & Robinson, Limited, Chatley, Fassett-rd, Surbiton

Robinson (Thomas) & Son, Limited, Engineers, Boiler Makers, &c, Railway Works, Rochdale. (*Robinson Rochdale*)

Robinson, W. H., Electrician and Electrical Engineer, Terrace-rd, Upton, London, E.

Robinson, William, Electrical and Mechanical Engineer, 54, Hemberton-rd, Clapham, London, S.W.

Robinson, Wm. Mosse, jun, Electrician, Wandle Bank, Wallington, Surrey

Robinson (Wm.) & Co, Limited, Manufacturers of Electric Light Shades and Reflectors, Cleveland-rd, Wolverhampton

*Robinson, Prof. William, M.E., Assoc.M.Inst. C.E., M.I.E.E. (Professor of Mechanical and Electrical Engineering, University College), and Mapperley View, Woodborough-rd, Nottingham.

Robinson (W. & J.) & Co, Electric Light Engineers, 50, Oriel rd, and 30, Regent-rd, Bootle

Robson, Stuart, Electrician, 45, Holland-rd, Brixton, London, S.W.

Rochdale Asphalte and Concreting Company, Walker-st, Rochdale, Lancs.

Rochford, John, Assoc.I.C.E.I., M.I.M.E., Consulting Engineer, Kingstown, co. Dublin

Rock, Charles M., Art Metal Worker, 106, Great Russell-st, London, W.C.

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Rock, Thomas, Electrical Engineer, 364, Gray's Inn-rd, London, W.C.

Rode, James, Consulting Engineer, &c., Oriel-chmbs, Water-st, Liverpool. (*Volta Liverpool*)

Rodgers, R., Secretary Anglo-Portuguese Telephone Company, Limited, and the Edison-Gower-Bell Telephone Company of Europe, Limited, 53, New Broad-st, London, E.C.

Roger (Robert) & Co, Makers of Steam Cranes and Winches, Stockton Iron Foundry, Stockton-on-Tees (*Roger Stockton-on-Tees, 4506*)

Rogers Bros, Electric Bell Fitters, 24, Churton-st, Pimlico, London, S.W.

Rogers Bros, Mica Merchants, 221, Bradford-st, Birmingham.

Rogers Bros, Electric Bell Fitters, 61, High-st, Watford.

ROGERS, FRANCIS MURRAY, Electrical, Mechanical and Chemical Expert, 21, Finsbury-pavement, London, E.C. (*Invaluable London.*) **See Advt., p. 597**

Rogers, G. F., Telegraph Contractor, 5 and 6, Great Winchester-st, London, E.C. (*Impact London, 265*)

Rogers (H.), Sons & Co, Metal Merchants, 85, Gracechurch-st, London, E.C.; and at 39A, New-st, Birmingham. (*Yaramaxe London*)

Rogers, H. J., Electrical Engineer, 208, High-st, Watford. (*Mechanical Watford*)

Rogers, J., Electrician, 29, Wood-st, Wellingborough.

Rogers, R. B., A.M.I.C.E., Consulting Engineer, 10, Gerald-rd, Eaton-sq, London, S.W.

Rogerson, W. C., Electrician, c/o P. and O. Steam Navigation Co, Leadenhall-st, London, E.C.

Rollason & Slater, Limited, Mechanical and Electrical Engineers, Mitre Works, Richmond-st, Birmingham; and Wombridge, Salop

Rollason's Wind Motor Company, Limited, Electrical Engineers, 3 & 4 Great Winchester-st, London, S.E. (H. R. Cobbett, Secretary)

Roller, George H. V., Electrician, 4, Randolph-cres, Maida-vale, London, W.

Rollins (J. G.) & Co, Limited, Dealers in Electrical Supplies, Old Swan Wharf, Upper Thames-st, London, E.C.

Ronalds, B., Electrical Engineer, 71, Francis-rd, Edgbaston, Birmingham

Ronketti, Joseph, Scientific Instrument Maker, 25, Northampton-rd, London, E.C.

Roome, Thomas John, Engineers' Pattern Maker, 48, Royal-rd, London, S.E.

Rooper & Harris, Ltd, Emery Wheel and Grindstone Makers, Stafford. (*Rooper Stafford*)

Rooper (W. O.) & Tozer, Electrical, Sanitary, and General Engineers, 11, Bridge-st, Northampton; and at Stafford (*Rooper Northampton*)

ROOTHAAN & ALEWIJNSE, Incandescent Lamp Makers, Nijmegen, Holland. **See Advt., p. 572**

Roots Oil and Gas Engine Company, Makers of Oil and Gas Engines, 261, High Holborn, London, W.C. (*Roots Holborn-place, London*)

Ropkins & Co, Limited, Manufacturers of Electric Wire Casing, &c., Nene Moulding Mills, Wisbech. (*Ropkins Wisbeach*)

Rorke, Thomas Joseph, Electrical Engineer, 17A, Great George-st, Westminster, London, S.W.

*Roscoe, Sir Henry Enfield, B.A., Ph.D., LL.D., D.C.L., F.R.S., F.C.P., M.P., 10, Bramham-gdns, London, S.W.

Rose & Co, Electrical Apparatus Makers, 62, Manchester-rd, Bradford, Yorks. (*Malleable Bradford*)

Rose, Downs & Thompson, Limited Engineers and Boiler Makers, Old Foundry, Hull. (*Rose Hull*)

Rose (Sir W. A.) & Co, Dynamo Oil Refiners and Grease Manufacturers, 66, Upper Thames-st, E.C., and Rose's Wharf, Bankside, S.E., London. (*Warose London*)

Rose (William) & Co, Electric Bell and Fire Alarm Manufacturers, Salford, Manchester.

Roskell & Co, Limited, Scientific Instrument Makers, 8 & 9, Martin's-lane, Cannon-st, London, E.C.

Rosling & Matthews, Manufacturers of Electrical Plant, Trafalgar Works, Bradford (*844*), and Porter-st, Hull (*432*) (*Magneto Bradford*)

Ross & Co, Mathematical Instrument Makers, 111, New Bond-st, W. (*3540*), and Worcester House, 3, Clapham Common, S.W. (*9134*), London.

Ross, Courtney & Co, Electrical and General Engineers, 25, Ashbrook-rd, Upper Holloway, London, N. (*Homonyns London*)

Ross (James) & Son, Engineers and Boiler Makers, Old Kent-road, London, S.E. (*Valveseat London 4918*)

Ross, J., Electrical Engineer (Arthur & Co) William-st, Anderston, Glasgow

Ross, John, Electrician, 3, Meadow-ter, Fentiman-rd, Lambeth, London, S.W.

Ross, M. G., Electrician, Manager Hastings and St. Leonards-on-Sea Electric Light Company, Limited, Earl-st, and 89, St. Helen's-rd, Hastings

*Ross, O. C. D., Electrician and Electrical Engineer, 15 and 17, Relf-rd, Peckham, London, S.E.

Ross & Walpole, Engineers and Boiler Makers, North Wall Iron Works, Dublin. (*Iron Dublin, 311*)

Ross & Wilkie, Electrical Engineers, Dundee

Rossendale Belting Company, Belting Manufacturers, 10, West Mosley-st, Manchester, and at London and Glasgow. (*Hair Manchester*)

Rossiter, A. E., Electrical Engineer, 45, Parliament Hill-rd, Hampstead, London, N.W.

Roth, Schmidt & Co, Manufacturers of Cable Wax, 6, Crosby-sq, London, E.C. (*Dryandra London*)

Rouch (W. W.) & Co, Chemical Glass and Photographic Apparatus Manufacturers, 180, Strand, and 43, Norfolk-st, Strand, London, W.C. (*Pyroxyline London*)

Round, John, Manufacturing Electrician, 3, Marmount-rd, Peckham, London, S.E.

Roundhay Electric Tramway (Thomson-Houston System), 1, Roseville-rd, Roundhay, Leeds. (J. E. Winslow, Manager) (*Tramway Leeds, 4027*)

Rounsivell, Wm. T., Electric Crane Builder, 121 and 123, Union-st, Borough, London, S.E.

Rousseau, Emile, Electrical Engineer, 17, Westdown-rd, Catford Bridge, London, S.E.

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Routledge, William, Dealer in Electrical Supplies, 46, Low Friar-st, Newcastle-on-Tyne

Routledge, W., Electrical Engineer, 49, Trinity-sq, London, S.E.

Rowan, F. J., Civil and Electrical Engineer, 121, West Regent-st, Glasgow. (*Barnacles Glasgow*)

Rowat (Alex) & Co., Wire Workers, 25, Candleriggs, Glasgow. (*Wirecloth Glasgow, 934*)

Rowbottom (S.) & Co., Electrical Engineers and Contractors, Arc Works, Curzon-st, Derby

Rowden, W. T., B.Sc., Consulting Engineer and Professor of Mechanical Engineering, Glasgow and West of Scotland Technical College, Glasgow

Rowe, Thomas, Telephone Engineer, Liverpool District National Telephone Company, Limited, K35, Exchange-bldgs, Liverpool

Rowell (D.) & Co, Wire Makers, &c., 5, Victoria-st, London, S.W. (*Rowell London*)

Rowland (W. H.) & Co, Electrical Agents, 308, Stretford-rd, Manchester

Rowlandson, Wm., Electrical Engineer, 67, Lord-st, Liverpool

Rowsell, P., Electrician, 14, Walcot-sq, London, S.E.

Roy, A. W., Maker of Electric Alarm Clocks, Small Dynamo Castings, &c., 67, Byker-hill, Newcastle-on-Tyne

Royal Astronomical Society, Burlington House, Piccadilly, London, W.

Royal College of Science, South Kensington, and Jermyn-st, London, S.W. (*For List of Professors, see page 270*)

Royal College of Science for Ireland, Dublin. (*For List of Professors, see page 270*)

Royal Crown Derby Porcelain Company, Limited, China and Earthenware Manufacturers, 42, Holborn-viaduct, London, E.C.

Royal Engineers' Institute, Chatham. (Capt. W. A. Gale, R.E., Secretary)

Royal Indian Engineering College, Cooper's Hill, Staines. (*For List of Professors, see page 273*)

Royal Institution of Great Britain, 21, Albemarle-st, London, W. (Lord Rayleigh, F.R.S., Professor of Natural Philosophy; Prof. J. Dewar, F.R.S., Fullerian Professor of Chemistry; Hon. Secretary, Sir Frederick Bramwell, Bart F.R.S.; Assistant Secretary, Henry Young) (*3669*)

Royal Laboratory, Royal Arsenal, Woolwich, London, S.E. (*Laboratory Woolwich*)

Royal Meteorological Society, 22, Great George-st, Westminster, London, S.W. (C. Theodore Williams, M.D., President; G. J. Symons, F.R.S., and F. C. Bayard, LL.M., Secretaries; W. Marriott, Assistant Secretary)

Royal Microscopical Society, 20, Hanover-sq, London, W.

Royal Observatory, Greenwich, London, S.E. (*For Officials, see page 233*)

Royal Physical Society, 18, George-st, Edinburgh. (W. Evans, F.R.S.E., Secretary)

Royal Society, Burlington House, Piccadilly, London, W.

Lord Kelvin, D.C.L., LL.D. ... President
Prof. M. Foster, M.A. ... ... } Secretaries.
Lord Rayleigh, M.A., D.C.L. ... }
Herbert Rix, B.A. ... ... Asst. Sec.
Sir J. Lister, Bart, M.D. ... ... Foreign Sec.

Royal University of Ireland, Earlsfort-ter, Dublin. (*For List of Professors, &c., see page 267*)

ROYCE (F. H.) & CO, Manufacturing Electricians, Cooke-st, Hulme, Manchester. (*Switch Manchester, Nat. 772*)

Royse (S. W.) & Co, Chemical, Mineral, and Metal Merchants, St. Andrew's-chmbrs, Albert-square, Manchester; and at Runcorn. (*Roys Manchester, 1889*)

Royston (J.), Son & Co, Telegraph and Telephone Wire Manufacturers, Shrogg's Mills, Halifax; and 44, Barbican, London, E.C.

*Rücker, Prof. Arthur W., M.A., F.R.S., M.I.E.E., 19, Gledhow-grdns, South Kensington, London, S.W.

Rudall, Francis, Telegraph Engineer London, Chatham, and Dover Railway Company, Victoria Station, Pimlico, London, S.W. (*3005*)

Rudd, J. A., Consulting Electrical Engineer, 128, Hope-st, Glasgow. (*Thorough Glasgow*)

Ruddle, Mark, Superintending Engineer of Electric Lighting to the Dublin Corporation, Central Station, and 45, London Bridge-rd, Dublin

Ruddock, A. E., Electrical Engineer, 65, Cumberland-st, Pimlico, London, S.W.

Rudge, John A. K., Electrician, 1, New Bond-st-pl, Bath

Ruffle, J., Electrician, 6, Gnoll Park-rd, Neath, South Wales

Rugby School Electric Lighting Company, Limited, Dunchurch-rd, Rugby
See also page 296.

Rushmer, F. F., Electrician, 21, Alexandra-rd, West Kensington, London, W.

Rushworth, A., Electrical Engineer, c/o Messrs. Ernest Scott & Mountain, Limited, Close Works, Newcastle-on-Tyne

Russell, A., Electrician, Swallowfield Park, Reading

Russell, A., M.A., Electrician, Electrical Standardising Laboratory, Faraday House, Charing Cross-road, London, W.C.

RUSSELL & CO, Electrical Engineers and Contractors, 11, Queen Victoria-st, London, E.C.; and 6, St. Andrew's-st, Cambridge. (*Ouketi London, Installation Cambridge*)

Russell, Earl, 11, Queen Victoria-st, London, E.C. (*Ouketi London*); and Amberley Cottage, Maidenhead

Russell (Geo.) & Co, Engineers and Crane Makers, Motherwell, near Glasgow. (*Russell Motherwell, 4*)

Russell, Capt. Henshaw, Manager Crystal Palace, Sydenham, London, S.E.

Russell, C. N., A.M.I.C.E., Electrical and Mechanical Engineer, Manager London and Lancashire Electric and General Engineering Company, Limited, Kingsland-green, Dalston, London, N.E.

Russell (James) & Sons, Limited, Iron Telegraph Pole and Tube Manufacturers, Crown Tube Works, Wednesbury; and at Leeds, Birmingham and London. (*Russell Wednesbury*)

Russell, John A., Electrical Engineer, Digby House, Hammersmith, London, W.

Russell (John) & Co, Electricians, 6, 8, and 10 Colston-st, Bristol (*218*)

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Russell (John) & Co, Limited, Wrought-Iron Tube Manufacturers, Alma Tube Works, and Cyclops Iron Works, Walsall, and at Wednesbury (Staffs) and London

Russell, N. Scott, Electrical Engineer, 39, Coleman-st, London, E.C.

Russell, T., Electrical Engineer, West Calder, Midlothian

Russell & Son, Wire Drawers, 73, Stibbington-st, Oakley-sq, London, N.W.

Rust, H., Electrician, Eastham, Cheshire

Ruston, Proctor & Co, Limited, Steam Engine Makers for Electric Lighting, &c., Sheaf Ironworks, Lincoln; and 20, Budge-row, London, E.C. (*Ruston Lincoln, Ruston London*)

Rutherford Science College, Newcastle-on-Tyne. (*For Teachers, &c., see page 274.*)

Rutherfoord, B., Electrical Engineer, Darver Castle, Castle Bellingham, co. Louth, Ireland

Ryan, G., Dealer in Electricians' Tools, 312, Euston-rd, London, N.W.

*Ryan, John, M.A., D.Sc., LL.M., Consulting Engineer and Electrician, University College, Bristol

Ryan, Wm. J., Electrician, 24, Aynhoe-rd, West Kensington, London, W.

Ryde Pier Company (and Electric Railway), Ryde, Isle of Wight. (Henry Roberts, Secretary and Manager)

Rylands Bros, Limited, Wire Manufacturers and Drawers, Church-st, Warrington (*Wire Warrington, 11*)

Rymer-Jones, J., Electrician, 22, Castletown-rd, West Kensington, London, W.; and Lanark House, Fairfield-rd, Charlton, Kent

Rymer-Jones, Thos. M., Consulting Engineer, 18, Parliament-st, S.W., and 28, Budge-row, Cannon-st, E.C., London

Ryves, E. J. T., Consulting Electrician, Maxim-Nordenfeldt Works, Dartford, Kent

— S —

Sabine, A., Secretary, Messrs, Siemens Bros. & Co, Limited, 12, Queen's Anne's-gate, Westminster, London, S.W.

Sadler, Hastings V., Electrical Engineer, 84, Burlington-st, Manchester

Safety Tread Syndicate, Limited, Makers of Electric Light Cover Boxes, &c., 15, Barbican, London, E.C.

Sachs, Carl J., Electrician-in-charge British Museum, Great Russell-st, Bloomsbury, London, W.C.

Sage (Charles) & Sons, Consulting Engineers, 2, Great St. Helens, London, E.C.

Sage (F.) & Co, Exhibition Show Case Makers, 80, Gray's Inn-rd, W.C. (*Sage London, 2637*)

St. George, A. F., Electro-Chemist, Cotswold House, Earlsbrook-rd, Earlswood, Redhill, Surrey

St. George's Iron Works, Limited, Engineers, Makers of Castings, Wheels, Pulleys, &c., Hulme, Manchester. (*Ormerod Grierson Manchester, 229*)

St. Martin's Electrical Manufacturing Company, Limited, 3, Peter's-court, St. Martin's-lane, London, W.C. (Charles Hancock, Secretary)

St. James and Pall Mall Electric Light Company, Limited, Carnaby-st, Golden-sq, W., and Mason's-yd, Duke-st, St. James', London, S.W. (*Licensable London, 3508.2*)

E. J. A. Balfour ... Chairman
Sydney T. Dobson... Chief Engineer
F. J. Walker ... ... General Manager and Secretary

See also page 296.

St. John, L. A., Electric Bell Manufacturer, 2, Prospect-pl, Leytonstone, London, E.

St. Pancras Ironwork Company, Engineers, 171-173, Pancras-rd, London, N.W.

ST. PANCRAS VESTRY ELECTRICITY DEPARTMENT, St. Pancras Vestry Hall, London, N.W. (*7539*)

T. Eccleston Gibb ... ... Vestry Clerk
Albert E. Pycraft ... ... Chief Clerk
Prof. H. Robinson ... ... Consulting Engineer & Electrician
James T. Baron ... .. Resident Engineer

(Central Station: 47, Stanhope-st, N.W.)

Salanson (A.) & Co, Electricians, 28, High-st, and 27, Bridge-st, Bristol

Sale, Colonel M. T., C.M.G., R.E., &c., Superintendent Works Department, Ordnance Factories, Royal Arsenal, Woolwich; and Ugie Bank, Abbey Wood, Kent. (*Military Works Woolwich*)

Salisbury-Jones, F. W., Electrical Engineer, Waterhouse Electrical Manufacturing Co., Ltd, 67, Southwark Bridge-rd, London, S.E.

Salt Lake and Ogden Gas and Electric Light Co., Limited, 251, Winchester House, Old Broad-st, London, E.C. (J. A. Kelman, Secretary)

*Salomons, Sir David, Bart., M.A., M.I.E.E., Consulting Electrician, Broom Hill, Tunbridge Wells; and 49, Grosvenor-st, London, W. (*Salomons Tunbridge Wells*)

Salopian Pottery Company, Makers of Porous Cells, &c., Benthall Pottery, Broseley, Shropshire

Salter (Geo.) & Co, Makers of Measuring and Testing Instruments, West Bromwich; and 101, Leadenhall-st, London, E.C.

Sambidge (H. W.) & Son, Makers of Electric Light Fittings, Highgate-st, Birmingham (*Sambidge Birmingham*)

SAMPSON and CO.,
STROUD, GLOUCESTERSHIRE,
Makers of
MAIN LEATHER DRIVING BELTS, *any Width, Length, or Strength, without Cross Joints,*
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Sample (James) & Co., Limited, Manufacturers of Detaching and Picking-up Gear for Ships' Boats, 63, Quayside, Newcastle-on-Tyne

Sampson Low, Marston & Co, Limited, Technical Publishers, St. Dunstan's House, Fetter-lane, London, E.C. (*Rivsam London, 2679*)

Samuel (W. H.) & Co., Lubricating Oil Manufacturers, 62, Dale-st, Liverpool. (*Machinery Liverpool, 882*)

Samuelson & Co, Limited, Engineers, Britannia Works, Banbury, Oxfordshire (*Samuelson Banbury*)

Sandberg, C. P., Consulting Engineer, 19, Great George-st, London, S.W.

Sanby & Co., Electric Light Engineers and Contractors, 6, Bridge-st, Southampton

Sanders, A. G., Electrical Engineer, Messrs. B. Verity & Sons, 29, Prince's-st, and 53, Bees-st, Moss Side, Manchester

Sanders, Thomas, Manufacturer of Electric Light Fittings, Ladywood, Birmingham; and 71, Queen st, London, E.C. (*Selected Birmingham*)

Sanderson, A. H., Electrician, Darfield, Marlborough-rd, Bournemouth

Sanderson & Co., Electric Light Engineers and Contractors, Blyth, Northumberland. (*Sanderson Blyth, 2510*)

Sanderson (C. J.) & Sons, Electricians, 30, Featherstone-st, City-rd, London, E.C.

Sanderson, George, Electrical Engineer, 203, Adelaide-rd, South Hampstead, London, N.W.; and c/o Messrs. Johnson & Phillips, Victoria Works, Old Charlton, Kent

Sandy, James, Electrician, 10, Gt. Sutton-st, London, E.C.

Sangster, John, Vulcanite Manufacturer, 8, Coleman-st, London, E.C.

Sanitary Engineering and Ventilation Company, Electric Light Engineers, 65, Victoria-st, London, S.W.

SANITAS COMPANY, Limited, The, Disinfectant Manufacturers, Letchford's-bldgs, Three Colt-lane, Bethnal Green, London, E. (C. T. Kingzett, Managing Director.) (*Sanitas London, 1011.*) **See Advt., p. 18**

*Sankey, H. R., Capt. R.E. (ret.), Ferry Works, Thames Ditton, and Bawnmore, Arterberry-rd, Wimbledon

Sankey (Joseph) & Sons, Armature and Transformer Stamping Works, Albert-st, Bilston, Staffordshire; and 88, Bishopsgate-st Within, London, E.C. (*Sankey Bilston*)

Sargeant, W. S., Manager Thames Electric and Steam Launch Company, Eel Pie Island, Twickenham, London, S.W.

Sarsons, Limited, Makers of Glass Globes and Shades for Electric Lighting Purposes, Chester Street Glass Works, Birmingham

Saul, David H., Electric Bell Maker, 126, Commercial-st, London, E.

Saunders, H. A. C., Chief Electrician to the Eastern Telegraph Company, Winchester House, Old Broad st, London, E.C.

Saunders (J. B.) & Co, Electrical Engineers, Cardiff. (*Electrician Cardiff*)

Saunders, W. H. R., Electrical Engineer, Cardiff

Saunders, John, Limited, Manufacturers of Electric Light Fittings, High-st, Kidderminster

Saunderson, F., C.E., Consulting Engineer to the Douglas and Laxey Coast Electric Tramway, Limited, Athol-st, Douglas, Isle of Man

Saunderson, L., Electrical Engineer, 10, Vesci-terrace, Kingstown, Dublin

Savage, G. C., Electrician, 6 and 7, Tysoe-st, Clerkenwell, London, E.C.

Savill, Arthur G., Electrical Engineer, Boleyns, Braintree

Saville, J. H., Electrician, 105, Philip-st, Patricroft, Manchester

Saville (J. J.) & Co., Magnet Steel Manufacturers, Shoreham-st, Sheffield. (*Saville Sheffield*)

SAX (JULIUS) and CO., Limited, Electrical Engineers and Electric Light Contractors, 7, Ridgmount-st, Bedford-sq, W.C., Charterhouse-st, and 366, Central Markets, West Smithfield, E.C., London. (*Sax London, 3848*)

Alfred Slatter, A.I.E.E. ... ... **Manager**

See also page 296.

Saxby & Farmer, Limited, Railway Signal Manufacturers, Canterbury-rd, Kilburn, London, N.W.

Sayer, George, A.I.E.E., Electrical Engineer, St. James's Gate Brewery, Dublin

Sayer, Henry J., Metal and Zinc Merchant, 21 and 22, Cambridge-st, Birmingham. (*Sayer Birmingham, 233*)

Sayer, John S., Consulting Electrical Engineer, 25, St. Leonard's-ter, Chelsea, London, S.W.

Sayers, J., Electrical Engineer, Electrical Department, Midland Railway, Derby.

Sayers, W. B., Electrical Engineer, Messrs. Mavor & Coulson, Orr-st, Calton, Glasgow, and Glenwood, Bearsden, near Glasgow

Scadding & Son, Electric Bell Fitters, Magdalen-st, Exeter

Scarborough Electric Supply Company, Limited, 102, Westborough, Scarborough

Lt.-Col. R. F. Steble, J.P. Chairman

A. A. Campbell Swinton { Managing Director and Consulting Engineer

John Hall ... ... Secretary

See also page 296.

Scargill, S., Electrician, 11, Home View-ter., Manningham, near Bradford

Scarth, Leveson, Electrician, 6, Thames-chambers, Adelphi, London, W.C.

Scattergood, B. P., M.A., Electrical Engineer, 41, Park-sq, Leeds

Schäffer & Budenberg, Steam, Vacuum and Hydraulic Gauge Makers, 1, Southgate-st, Manchester, and at Glasgow and London. (*Manometer Manchester, 899*)

Schall, K., Electro Medical Instrument Maker, 55, Wigmore-st, London, W. (*Schall London*)

Schanschieff, A., Electrician, Clifton-avenue, The Avenue, Upper Norwood, London, S.E.

Schiassi, H., Electrical Engineer, 34, Glebe-rd, Bromley, Kent

Schiattino, F. D., Electrician, 8, Regent-st, London, W.

Schiele Union Engineering Company, Limited, Makers of the "Schiele" Fan Air Propeller, Turbines, &c., Pollard-st East, Ancoats, Manchester; and 11, Queen Victoria-st, London, E.C. (*Schiele Manchester, 989*)

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Schiller, F. W., Electrician, 205, Brixton-rd, London, S.W.

Schmidt, F. T., Electrical Engineer, 9, Clarendon-road, Bradford

Schneider, Adolph, B.A., Electrical Engineer, c/o Messrs. W. T. Goolden & Co., Woodfield Works, Harrow-rd, London, W.

Schofield, Allen, Electrician, 49, Rock Nook Summit, Littleborough, Lancashire

Schofield, B., Maker of Electric Pushes and Pulls, Diggle, near Oldham

Schölzig, Oscar, Agent for Glass Globes, Reflector Shades, Accumulator Boxes, Carbons and Incandescent Lamps, 9, New Broad-st, London, E.C. (*Scholzig London*)

School of Engineering, Polytechnic Institution, 309, Regent-st, London, W.

School of Practical Engineering, &c., Crystal Palace Company, Sydenham, London, S.E.

SCHOOLS, COLLEGES, UNIVERSITIES, &c.—(*For Professors, &c., see pages 264 to 273*)

Schoth, G. A., Electro Medical Apparatus Maker, 170A, Great Portland-st, London, W.

Schram (Richard) & Co, Air Compressor Makers, 17A, Great George-st, Westminster, London, S.W. (*Schram London*)

Schramm, Louis, Electrical Engineer (Messrs. Wyand & Sons), 15, Lower Grosvenor-pl, London, S.W.

Schreiber & Neffen (Vienna), Electric Light Shade Makers, 25, Fore-st-avenue, London, E.C. (Kiesow & Co, Agents)

Schultz, George, Chief Engineer Notting Hill Electric Lighting Company, Limited, Bulmer-pl, High-st, Notting-hill, London, W.

Schultze, O., Electrician and Electro Plater, Sussex-rd, Southampton

Schurr, Albert Ebenezer, Electrician, Lyncot, Leigh-on-Sea, Essex

Schuster, A., Ph.D., F.R.S., Professor of Physics, Owens College, Manchester

Schwann & Co, Copper Merchants, 6, Moorgate-st, London, E.C. (*Schwann London, 89*)

Schwarte & Hammer, Electrical Copper Wire Manufacturers, 6, Lime-st, London, E.C. (*Schwartham London, 4030*)

Science and Art Department, Cromwell-rd, South Kensington, London, S.W. (*For Officials, see p. 231*)

Science and Art of Mining (fortnightly), 27, Wallgate, Wigan (C. M. Percy, M.E., F.G.S., Editor) (Price 3d.)

Scientific Alliance, Manufacturing Electricians, Apparatus for Inventors, &c., 7 and 8, Dyers-buildings, Holborn, London, E.C. (Henry J. Dale, Manager)

Scientific Apparatus (monthly), 35, Silver-st, Leicester. (*Quotations Leicester, 399*)

Scientific Publishing Company (of New York), 20, Bucklersbury, London, E.C. (Edward Walker, Representative)

Scientific Supply Company, Manufacturers of Photographic and Electrical Apparatus, 13, Theobald's-rd, London, W.C.

Sclater, Arthur W., Electrical Engineer, 182, Oxford-st, London, W. (*Enitco London*)

Scott, Allen F., A.I.E.E., Electrical Engineer, 41, Piccadilly, Bradford (*83*)

Scott, Prof. A. W., Professor of Physical Science, St. David's College, Lampeter, South Wales

Scott (E.) & Co, Makers of Scott's Oil Engines, 23, Guardian-bldgs, Manchester

Scott, Ernest, Specialist in Electric Mining Work, Brush Electrical Engineering Company, Limited, Falcon Works, Loughborough

Scott (Ernest) & Mountain, Limited, Electrical and General Engineers and Brass Founders, Close Works, Newcastle-on-Tyne; and 5, Crown-st, Cheapside, London, E.C. (*Esco Newcastle-on-Tyne, 432; Potential London*)

Scott, F. W., Wire Rope Manufacturer, Atlas Steel Wire Works, Reddish; and 26, Martin's-lane, London, E.C.

Scott & Hodgson, Steam Engine Makers, Guide Bridge, nr Manchester. (*Engines Hooley Hill, 67*)

Scott, H. H., Engineer to the Hove Commissioners, Town Hall, Hove

Scott (James) & Co., Electrical Engineers, 9, Tottenham-st, London, W.

Scott, James, Secretary to the Cuba Submarine Telegraph Company, Limited, 58, Old Broad-st, London, E.C.

Scott, J. C., M.A., Consulting Electrical Engineer and Teacher of Electricity, Laboratory, 14, North-rd, Surbiton

Scott, John, Electrical Engineer (D. & G. Graham, Sauchiehall-st), 134 to 140, Douglas-st (*81*), and 201, Byres-rd, Dowanhill, Partick (*2043*), Glasgow (*Telephone Glasgow*)

Scott, Ronald A., Electrical Engineer, Acton Hill, London, W. (*Scott Acton Hill, W.*)

Scott & Sellar, Electrical Engineers, Aberdeen

Scott, Sergt.-Major J. T., Telegraph Engineer, Postal Telegraphs, 10, Leicester-sq, London, W.C.

Scott, W. G., Chief Engineer, Central Station, Cheshire Lines Railway Co, Liverpool

Scott, W. H., Electrical Engineer (Messrs. Laurence, Scott & Co, Limited), Gothic Works, King-st, Norwich

Scottish Electric Supply Company, Limited, 5, North St. David-st, Edinburgh

Scottish House-to-House Electricity Company, Limited, 109, Hope-st, Glasgow. (R. B. Jarne, Secretary)

See also page 296

Scottish India Rubber Company, Makers of Insulating Materials and Telephones, 45, Queen-st, Glasgow. (*Proof Glasgow, 690*)

Scottish Vulcanite Company, Limited, View Forth, Edinburgh; 33, Piccadilly, Manchester; 67, Fore-st, London, E.C.; and at Paris. (*Vulcanite Edinburgh*)

Scrap Metal Company, Brass and Copper Merchants, 138, Palmerston Buildings, London, E.C. (W. H. Barnard, Manager)

Scrutton, Percy E., Electrical Engineer, 24, Queen Victoria-st, London, E.C.

Seager, Laurance, Electric Light and Telephone Contractor, London-rd, Sittingbourne, Kent

Seal, J., Maker of the Seal Gas Engine, 67, Carthew-rd, Hammersmith, London, W.

Searle, G. F. C., M.A., Demonstrator of Experimental Physics, Cavendish Laboratory, and 11, Scroope-ter, Cambridge

Sea Side Polytechnic, Bournemouth (Managing Director, W. McGregor)

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Seaman, Arthur G., Electrical Engineer, Prestonhouse, Surbiton-rd, Surbiton

Seath (T. B.) & Co, Builders of Electric Launches, Rutherglen, and 42, Broomielaw, Glasgow

Seaton, W. Sharpey, Assoc.M.Inst.C.E., M.I.E.E., Consulting Electrical Engineer, 57½, Old Broad-st, London, E.C. (*Gulfstream London*)

Sectional Standards, Limited, Makers of Telegraph and Electric Light Poles, 38, Lime-st, London, E.C. (*Herman London*)

Seddon, Col. —, late R.E., Consulting Engineer, 27, Chancery-lane, London, W.C.

Sedgwick, F. W., Electrical Engineer, Jesmondhouse, Epsom

Segundo, E. C. de, Assoc.M.I.C.E., Consulting Electrical Engineer, 28, Victoria-st, London, S.W. (*Awesome London*)

Selden & Son, Electrical and Sanitary Engineers, Smiths, and Zinc Workers, 120, King-st West, Hammersmith, London, W.

SELIG, SONNENTHAL & CO., Engineers' Tool Makers, 85, Queen Victoria-st, and Lambeth-hill, London, E.C. (*Selig London*). **See Advts., pp. 4 to 7.**

Selinger, Morris, Mica Merchant, 8, Nicholas-st, Mile End-rd, London, E.

Self-Winding Electrical Clock Co, Electric Clock Makers, 39, Victoria-st, London, S.W.

Selley (John) & Co, Engineers and Model Makers, 11A, Bissell-st, Birmingham

*Sellon, John S., Assayer and Metallurgist, The Hall, Sydenham, London, S.E.

Sellon, Robert Percy, Joint Manager Brush Electrical Engineering Company, 49, Queen Victoria-st, E.C., and 4, Chandos-st, Cavendish-sq, W., London (*Magneto London, 4564*)

Sellon, S. P. W. D'Alte, Electrical Engineer, Electric Construction Co, Limited, Queen-st-chmbrs, Queen-st, London, E.C.

Sells, John R., Electrician, 1, Eleanor-villas, Durant's-rd, Ponder's End, London, N.

Sennett, A. R., Electrical Engineer, Temple-chambers, Temple-avenue, London, E.C.

Serpollet Syndicate, Limited, Electrical and Mechanical Engineers, 5, 6, and 7, Broad-st-avenue, London, E.C.

Service (Geo.) and Co, Engineering Contractors and Agents, 88, Bishopsgate-st Within, London, E.C. (*Noscitur London*)

Sevenoaks, W., Electrical Engineer, Liquidator of the Windsor and Eton Electric Light Company, Limited, Acre House, Windsor

Severn Water Power Company, Hydraulic Power and General Engineers, Shrewsbury.

Sewell & Co, Electric Light Engineers, 24 and 26, River-st, Bolton

Sewill, J., Ships' Telegraph Manufacturer and Optician, 61, Castle-st, and 14 and 16, Canning-pl, Liverpool. (*Time Liverpool, 658*)

Seymour, William, Electrical Engineer and Contractor, 94 and 188, Walton-st, Chelsea, London, S.W. (*8757*)

Shalders, F., Electrician, 17, High-st, Southampton. (*Shalders Southampton, 6*)

Shanks (Alex.) & Son, Steam Engine Manufacturers, Dens Iron Works, Arbroath, and 110, Cannon-st, and 5, Old Swan-lane, London, E.C. (*Shanks Arbroath; Shankson London, 1670*)

Shann, George, Electrician, 3, Park-row, Albert Gate, London, S.W.

Share (Geo. W.) & Co, Dealers in Telegraph and Telephone Wire, 72, King William-st, London, E.C.

Sharp & Kent, Engineers and Electricians, 34, VICTORIA-STREET, S.W., and 73, Queen Victoria-street, E.C., London. (*Megavolt London, 3125*)

Sharp, Sidney, Electrician, 34, Victoria-st, London, S.W. (*Megavolt London, 3125*)

Sharp, Stewart, & Co, Limited, Machine Tool Makers, Atlas Works, Glasgow; and 2, Laurence Pountney-hill, London, E.C. (*Loco Glasgow; Gryphon London*)

Sharpe, J. P., Electric Light Engineer and Contractor, County-chmbrs, Corporation-st, Birmingham

Sharpe, J. W., Electrician, Woodroffe, Portarlington-rd, Bournemouth

Sharples, George, Electrical and Telegraph Engineer, &c., 7, Fishergate, Preston, Lancs. (*Sharples Preston, 190*)

Sharples, Wm. Hy., Electrician, 608A, Old Ford-rd, London, E.

Shaw, John, Electrician, Fern Lea, Grosvenor-sq, Sale

Shaw (John) & Co, Cast Iron Pipe Founders, Maryhill Iron Works, Glasgow. (*Shaw Glasgow, 532*)

Shaw, E. A., Electrician, 28, Stavordale-rd, Highbury, London, N.

Shaw, L. G., Electrician, The Grove, St. Andrew's-rd, Huddersfield

Shaw (William A.) & Co, Telephone Contractors, 6, Warren-st, Stockport

Shean, Arthur W. C., Consulting Engineer, 18, Finsbury-circus, E.C., and 31, Broadway, London, S.W.

Shearod (G.) & Co, Makers of Signs in Enamel, Wood, &c, 2, Praed-st, London, W.

Sheath Bros, India Rubber and Gutta Percha Makers, 89, City-rd, London, E.C.

Sheffield Electrical Engineering Company, Electrical Engineers, Hope Works, 50, Napier-st, Sheffield

Sheffield Electric Light and Power Company, Limited, Commercial-st, Sheffield. (Wm. Johnson, Manager and Secretary.) (*Electricity Sheffield, 9*)

See also page 296

Sheffield, F., Electrical and Sanitary Engineer, 29, Whalley-rd, Accrington

Sheffield Nickel and Silver Plating Company, Electro Platers, Globe Works, Penistone-rd, Sheffield

Sheffield Smelting Company, Limited, Platinum Refiners, Sheffield; and 1, Berry-st, Clerkenwell, London, E.C. (Thos. H. Morton, London Manager.) (*Smelters Sheffield*)

Sheffield Technical School, Sheffield (*For List of Professors and Lecturers, see p. 271*)

Sheffield Wire Company, Wire Drawers, Spring Manufacturers and Steel Refiners, Sylvestergdns, Arundel-st, Sheffield

Sheldrake (W. W.) & Son, Manufacturers of Castings for Electricians, Martin-st, Stratford, London, E.

Sheldrick, J. T., Consulting Engineer, 11, Queen Victoria-st, London, E.C.

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Shelford, William, Consulting Engineer, 35A, Great George-street, Westminster, London, S.W. (*Usefulness London*)

Shephard, W. H., Electrician, 40, Lansdowne-gdns, South Lambeth, London, S.E.

Shepherd, A. L., Electrical Engineer, Planet Electrical Engineering Company, Limited, 28, Victoria-st, London, S.W.

Shepherd, E. L., Electrician and Metal Trades Valuer, Abingdon, Berks; and 9, Charterhouse-st, London, E.C.

Shepherd, F., Telegraph Engineer, Postal Telegraphs, Mount Pleasant, London, E.C.

Shepherd, R., Electrician, 85, Coldharbour-lane, Camberwell, London, S.E.

Shepherd & Watney, Civil and Electrical Engineers, 71, Albion-st, Leeds (*Energy Leeds*

Sheppard, Allarton and Madeley, Makers of Gongs for Electric Bells, &c., Clement-st, Birmingham

SHERBORNE ELECTRIC INSTALLATION, Electrical, Fire, and Mechanical Engineers, Sherborne, Dorset. (E. R. Dale, A.I.E.E., Mem. Soc. Arts, Secretary)

Sheridan Bros., Electrical Engineers and Contractors. 27, Lower Abbey-st, Dublin

Sherley-Price. Henry (of Wheatley Kirk, Price and Goulty, Electrical and Mechanical Auctioneers, Arbitrators and Valuers), 49, Queen Victoria-st, London, E.C. (*Indices London*)

Sherman (Stephen) & Son, Electric Light Lamp Makers, 26-28, New Compton-st, 171, Shaftesbury-avenue, and 5, Bucknall-st London, W.C.

Shettle, Dr. Richard C., Electrician, 73, London-st, Reading

Shiels & Elliot, Electric Light Engineers and Contractors, West Nile-st, Glasgow

Shillingford Works Company, Limited, Electricians, Wallingford, Berks. (*Shillingford Works Dorchester Oxon*)

Shillitoe, H. S., Electrician, Hatfield House, Hatfield, Herts

Shipman (Jabez) & Co, Telegraph Wire Manufacturers, Attercliffe Steel Works and WireMills, Sheffield. (*Shipman Sheffield, 465*)

Shippey Bros, Limited, Electrical Engineers, 13 and 14, King-st, London, E.C. (*Shippey Brothers London*)

Shipton, F. H. E., Electrical Engineer, Orchard-st, Wandsworth, London, S.W.

Shirley & Co, Manufacturers of Electric Light Fittings, 45, Rathbone-pl, Oxford-st, London, W.

Shirras (Wm) & Son, Electric Bell Manufacturers, 44, School-hill, Aberdeen

Shoolbred, H. G., Electrician, Hamelyn, Kingston-rd, Merton-pk, Surrey

Shoolbred (James) & Co, Electric Light Engineers, 151-156, Tottenham Court-rd, London, W.C. (*35,20* and *17,20*)

Shoolbred, J. N., B.A., M.I.C.E., Consulting Electrical Engineer, 47, Victoria-st, London, S.W.

Shorrock, J. & R., Mechanical Engineers, 60, Queen Victoria-st, London, E.C. Works: Bolton-rd and Lee Foundries, Darwen, Lancs. (*Victor Feeny London*)

Shorrock, L., Electrical Engineer, Low Hill, Darwen, Lancs.

Short & Mason, Scientific Instrument Makers, &c., 40, Hatton-gdn, London, E.C. (*Aneroid London*)

Short, John, Mathematical Instrument Maker, 2, Gladstone-ter, Southwark, London, S.E.

Shorthouse, B. & G., Manufacturers of Electric Wires, Spring Hill Mills, Eyre-st, Birmingham. (*Shorthouse Birmingham*)

Shoubridge, S. Yarrell, Engineer and Manager of Gas and Electric Lighting Department, Borough Gas Offices, Bloom-st, Salford, Manchester. (*Gas Salford*)

Shropshire Electric Light and Power Company, Limited, 9, The Square, Shrewsbury

See also page 296

Shropshire Iron Company, Limited, Telegraph Wire Manufacturers, Hadley, near Wellington, Salop. (*Sun Wellington Salop*)

Shurmer, J., Secretary of the Elmore (Parent) Group of Patent Copper Depositing Company, Limited, 5, Laurence Pountney Hill, London, E.C. (*Revolutionize London*)

Shuter, William, Managing Director Telegraph Construction and Maintenance Company, Limited, 38, Old Broad-street, London, E.C.

Sibley (F.) & Co, Electrical Engineers and Contractors, 7 & 8, Working-st, Cardiff

Siddalls, J., Borough Engineer, Town Hall, Tiverton

Siebe, Gorman & Co. Submarine and Electrical Engineers, 187, Westminster Bridge-rd, and Neptune Works, Mason-st, Lambeth, London, S.E. (*Siebe London, 4769*)

*Siemens, Alexander, Civil Engineer (Director of Siemens Brothers & Co, Limited), 12, Queen Anne's-gate, Westminster, London, S.W.; and Woolwich. (President of the Institution of Electrical Engineers for 1894), (*Siemens London, 3099*)

SIEMENS BROTHERS & CO, Limited, Telegraph and Electrical Engineers and Contractors, 12, Queen Anne's-gate, Westminster, London, S.W.; and Woolwich. (*Siemens London, 3099*)

Carl Siemens ... ... **Chairman**
Alex. Siemens ... ...
Arnold von Siemens ... ... } **Directors**
Georg W. von Siemens ... ...
A. Sabine ... ... **Secretary**

Manufacturers of—
Submarine and other Cables
Telegraph Apparatus
Torpedo Apparatus
Electric Light Apparatus
Iron Telegraph Posts
and
Electrical and Telegraph Materials of all kinds

See Advt. inside front cover, *and also page 296*

Silcock, E. J., A.M.I.C.E., F.G.S., Borough Engineer, King's Lynn, Norfolk

Sillar, A. M., Electrician and Technical Instructor to the Vestry, Town Hall, Shoreditch; and 3, Prince's-mansions, Victoria-st, London, S.W.

Sillar, G. C., M.I.E.E., Factory Manager Brush Electrical Engineering Company, Limited, Falcon Engine Works, Loughborough

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Sillery, William, Electric Light Engineer and Contractor, Chester-st, Wrexham

Silverthorne, Arthur, Consulting Engineer, 5, Victoria-st, London, S.W.

Silvester, Harry, F.I.C., F.C.S., Electro-Metallurgical Chemist, Holybead-rd, Handsworth, Staffs

Silvesters, Electrical and Mechanical Valuers, Newcastle, Staffs. (*Silex Newcastle*)

Simkins, A. R. M., M.S.A., F.R.M.S., M.I.E.E., c/o The Institution of Electrical Engineers, 28, Victoria-st, London, S.W.

Simmons, Geo. Alexander, Scientific Instrument Maker, 90, Hatton-gdn, London, E.C.

Simon, Henry, Maker of Simon's Action Turbine, 20, Mount-st, Manchester. (*Reform Manchester*)

Simon, H. F., Electrical Engineer, 38, Princes-sq, Bayswater, London, W.

Simons, Frederick A. A., Electrician, Nilgiri House, Camberwell, London, S.E.

Simpkin, Marshall, Hamilton, Kent & Co, Limited, Technical Publishers, 4, Stationers' Hall-ct, E.C., 23, 31 and 32, Paternoster-row, E.C., and 317, Strand, W.C., London (*Simpkin Marshall London*)

Simpson, G. P., B.Sc., M.I.E.E., M.Phys.S. (Messrs. Siemens Bros & Co), 12, Queen Anne's-gate, Westminster, London, S.W.

Simpson, S. L., Electrical Engineer, 11, Lower Parkfields, Putney, London, S.W.

Simpson, Strickland & Co, Makers of Electric Light Engines, Dartmouth. (*Engineers Dartmouth*)

Sinclair, Alex., Assoc.M.Inst.C.E., Engineer and Electrician, Hafod Works, and 7, Uplands-cres, Swansea

*Sinclair, Dane, Engineer and Electrician-in-Chief, National Telephone Company, Limited, Oxford-ct, E.C., and 48, Tierney-rd, Streatham Hill, S.E., London. (*9140*)

Sinclair, H., Electrical Engineer, 16, St. Helen's-place, London, E.C.

Singer, P. E., Electrician, 19, Kensington-court, London, W.

SINGLE-WIRE MULTIPLE TELEPHONE SIGNAL COMPANY, Limited, Electric Street Fire Alarm Makers, 11, Old Broad-st, London, E.C. (G. R. Neilson, Secretary)

See also page 296.

Sington (A.) & Co, Electrical Engineers, 31, Portland-st, Manchester. (*Singtons Manchester, 1073*)

Sinnott, John, Electrician, Upper Dew-st, Haverfordwest

Sisling, W. B., Consulting Electrical Engineer, c/o Messrs. Laurence, Scott & Co, Limited, Gothic Works, Norwich; and Hamilton Drive, The Park, Nottingham

Sisson (W.) & Co, Dynamo Engine Builders, Quay-st, Gloucester

Skelton (H. J.) & Co, Metal Merchants, 12, Lime-st, London, E.C. (*Hiskelton London*)

Skilton, S. J., Electrical Engineer, Wardrobe-chmbrs, Queen Victoria-st, London, E.C.

Skirrow, B. B., M.A., Lecturer in Physics and Electrical Engineering, Manchester Municipal Technical School, Manchester

Skudder (G.) & Co, Oil Merchants, 98, Tooley-st, London, S.E. (*Skudder London, 4899*)

Slag Reduction Company, Limited, Makers of Magnetic Separators for Extracting Metals, 2, Suffolk-lane, London, E.C.

Slark, Henry John, Electrical and Mechanical Engineer, Stanley House, Walham Green, London, S.W. (*Slark Walham Green*)

Slater, Alex., Electrical Engineer, Public Library, Edinburgh

Slater (James) & Co., Electrical Engineers and Art Metal Workers, 251, High Holborn, London, W.C. (*2715*)

Slater, Ernest, Electric Light and Power Engineer, 19, Great George-st, Westminster London, S.W.

Slater & Oakes, Telegraph Engineers, Telegraph Instrument and Electrical Apparatus Manufacturers, Traffic-st, Derby

Slater & Palmer, Telegraphic Ink Manufacturers, 8, Wine Office-court, Fleet-st, E.C., and Marsh Gate-lane, E., London. (*Palmink London*)

Slatter, Alfred, Electrical Engineer, Manager Julius Sax and Co., Limited, 7, Ridgmount-st, Store-st, London, W.C. (*3848*)

Sleeman, C. W., Electrician, 12, Bessborough-st, Pimlico, London, S.W.

Sleigh, J. P., A.I.E.E., Electrical Engineer, Demonstrator in Electrical Department, Finsbury Technical College, Leonard-st, E.C., and 140, Hither Green-lane, Lewisham, S.E., London

SLINGO & BROOKER, Consulting Engineers, 65, Chelsham-rd, Clapham, London, S.W.

Slingo, W., Principal of the Telegraphists' School of Science, St. Martin's-le-Grand, London, E.C.

Small, James, A.M.I.C.E., Consulting Electrical Engineer (Urquhart & Small), 17, Victoria-st, London, S.W.

Sloper, Thomas B., Electrician, 14, Brittox, Devizes

Smedley Bros, Limited, Engineers, Ironfounders and Boiler Makers, Belper, Derbyshire. (*Smedleys Belper, 512*)

Smeeton, C. H., A.I.E.E., Electrical Engineer, 63, Queen Victoria-st, London, E.C.

Smeeton & Page, Electrical Engineers and Contractors, 63, Queen Victoria-st, London, E.C.

Smelt, John Dann, Civil and Mechanical Engineer, Finsbury-circus, London, E.C. (*Azodnem London*)

Smethurst & Co, Makers of Electric Light Fittings, 2, Duke-st-mansions, Grosvenor-sq, London, W.

Smethurst & Harbut, Manufacturers of Casings and Cleats, New-rd, Radcliffe, near Manchester

Smidth (F. L.) & Co, Consulting Engineers for Cement Works, Lime Works, and Brick-makers, 18, Parliament-st, Westminster, London, S.W. (*Chalkiness London*)

Smillie, J. A., Electrical Engineer, 106, Caledonian-rd, London, N.

Smillie (R. D.) & Co, Electrical Engineers and Contractors, 80, Mains-st, Glasgow. (*Anode Glasgow*)

Smith, Alexander, Agent for Henley's Electric Cables, 45, Queen-st, Glasgow (*Proof Glasgow, 698*)

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Smith (Archibald) & Stevens, Electric Bell Fitters, &c., Janus Works, Queen's-rd, Battersea, London S.W. (*Hydraulics London*)

Smith (A. & W.) & Co, Engineers and Boiler Makers, Eglington Engine Works, Glasgow; and 17, Victoria-st, London, S.W. (*Engine Glasgow*)

Smith, Arthur & David, Electric Light Engineers, Pier Engine Works, Thames-pl, Limehouse Hole, London, E.

Smith Brothers, Electrical Engineers, Northampton

Smith, B. G., Electric Crane Builder, Stannary-st, Halifax

Smith, B. L., Electrician, Scalands, Robertsbridge, Sussex

Smith, C. B., Electrician, Hove Electric Lighting Company, Cromwell-rd, Hove, Sussex

Smith, C. E., Electrical Engineer, Messrs. Christy Brothers, Broomfield-rd, Chelmsford

Smith & Chamberlain, Limited, Electrolier and Fittings Makers, Solar Works, Birmingham. (*Solar Birmingham*)

Smith, Charles James, Electric Light and Electric Bell Contractor, 23, King-st, Golden-sq, London, W.

Smith (Charles) & Sons, Limited, Electric Light Fittings Makers, 12, Oxford-circus-avenue, London, W.; and at Birmingham

Smith, Dixon & Lodge, Dynamo Oil Manufacturers, Harper-st Oil Works, Leeds. (*973*)

Smith (E. & A.) & Co, Limited, Steel Wire Manufacturers, Cleckheaton, Yorkshire (London Agent, W. T. Ross, 29, Ely-pl, Holborn, E.C.) (*Smiths Cleckheaton, 1325*)

Smith, E. W., Electrical Engineer, 68, College-st, Chelsea, London, S.W.

Smith, F. B., Electric Bell Fitter, 20 and 22, Queen-st, Watford

Smith (F.) & Co, Telegraph Wire Makers, Caledonia Works, Halifax. (*Smith Halifax*)

Smith, F. W., Electrical Engineer, Waterside, Knaresborough, Yorks

Smith (George) & Co, Manufacturers of Electric Lamp Pillars and Underground Mains, Sun Foundry, Glasgow; and 199, Upper Thames-st, London, E.C. (*Sun Glasgow, 1036*; *Perennial London, 15001*)

Smith, G. E., Electrician, 3, Spruce-yard, N. Sherewood-st, and 58, Mapperley-rd, Nottingham

Smith & Grace, Patent Screw Boss Pulley Makers, Thrapston; and Cornwall-bldgs, 35, Queen Victoria-st, London, E.C. (*Grace Thrapston*)

Smith, G. J., Telegraph and Electric Light Instrument Jeweller, 17, Malta-st, Clerkenwell, London, E.C.

Smith, Harold, Consulting Electrical Engineer, Colne

Smith, Henry, Electrical Engineer, 2, Curtain-rd, London, E.C.

Smith, H. King, Electrical Engineer and Contractor, 24, Upper Thames-st, London, E.C.

Smith, H. Whitmy, Electrician, Towerfield, Northampton

Smith, J. Bucknall, Electrician, 90, Wickham-gdns, St. John's, London, S.E.

Smith, J., Electrical Instrument Maker, 8 Balmoral-grove, Colwick, Nottingham

Smith, John, Electric Bell Fitter, 33 and 34, North-st, and 22, Bread-st, Brighton

Smith (John) & Co, Electrical Engineers, Winmanleigh, Lostock Park, Lostock Junction, Bolton, Lancs.

Smith (John) & Sons, Brass and German Silver Merchants and Founders, 18, St. John's-sq, Clerkenwell, London, E.C.

Smith (Jonas) & Co, Makers of Casings for Electric Wires, 98, Belvedere-rd, Lambeth, London, S.E. (*Moulding London, 4695*)

Smith, J. & W. B., Makers of Glass Globes for Electric Light, 21 & 23, Farringdon-rd, London, E.C.

Smith, M. Holroyd, Electrical and Mechanical Engineer, 161, Trinity-rd, Upper Tooting, London, S.W.

Smith, Prof. Robert H., M.I.M.E., M.I.E.E., A.M.I.C.E., Professor of Civil, Mechanical, and Electrical Engineering, and Consulting Engineer, Mason Science College, and 124, Hagley-rd, Birmingham

Smith, R. A., Electrical Engineer, Messrs. Dorman and Smith, Ordsal Station Electrical Works, Salford, Manchester

Smith, Raynes & Co, Makers of Electric Light Fittings, 18, Eldon-st, London, E.C.

Smith, Rev. F. J., M.A., Millard Lecturer in Engineering and Mechanics, Trinity College, and 28, Northam-gdns, Oxford

Smith, Robert A., Electrician, R. Waygood & Son, Falmouth-rd, S.E., and Innesfallen, 31, Strawberry Hill-rd, S.W., Twickenham, London

Smith & Robinson, Electricians, 42, Spencer-st, Goswell-rd, London. E.C.

Smith (S.) & Son, Non-Magnetisable Watch and Chronograph Makers, West Strand Observatory, 9, Strand, London, W.C.

Smith, Thomas, Electrical Engineer, 46, South Hill-park, Hampstead, London, N.W.

Smith, T. B., Electric Bell Fitter, 20 and 22, Queen-st, Watford

Smith (T.) & Co, Electro Platers, 10 & 11, Percival-st, Clerkenwell, London, E.C.

Smith, Theophilus, Telegraph Engineer, 9, Victoria-rd, Old Charlton, London, S.E.

Smith, Thomas, Engineer, Maker of Electric and other Cranes, Lifts, &c., Steam Crane Works, Rodley, near Leeds. (*Smith Rodley, 2018*)

Smith, Thomas Henry, Electrician, 8, East Parade, Leeds

Smith, T. & W., Wire Rope Manufacturers Newcastle-upon-Tyne; and at London. (*Smiths Newcastle-on-Tyne*)

Smith (W. Shaw) & Co, Electrical Apparatus Agents, 20, Tanfield chmbrs, Hustlergate, Bradford.

Smith, Walter J., Electrical Inspector to the Toxteth Park Local Board, Toxteth Park, Liverpool

Smith, Wm. F., Electrical Engineer, 7, Blenheim-st, London, W.

Smith, W., Electrician (Messrs. Benham & Sons Limited), 50-54 and 66, Wigmore-st, London, W

Smith, William O., Telegraph Engineer, Messrs Elliott Bros, 101 St. Martin's-lane, London W.C. (*Ohm London, 3852*)

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Smith, W. S., B. Sc., Electrical Engineer, 13, Courtfield-rd, S. Kensington, London, S.W.

Smiths & Co, Limited, Electrical Engineers and Contractors, 89, George-st, Edinburgh. (W. Finlay, Manager of Electrical Department)

Smyth, A. M., Electrical Engineer, Central Electric Light Station, Richmond, Surrey

Smyth, Holdom & Co, Electrical Engineers, 123, Lancaster rd, W., and 2, Great Russell-st, W.C., London

Smyth (Sydney) & Sons, Engineers, Basford Brass Works, Nottingham

Smyth, J. McFall, Electrician, Gloucester House, New Barnet

Smythe, Carrington R. G., A.I.E.E., Electrical Engineer and Manager for Messrs. J. H. Holmes & Co, 27, Bothwell-st, and 5, Doune-quadrant, Kelvinside, Glasgow

Smythe, Francis, Engineer and Surveyor to the Local Board, Church End, Finchley, London

Smythe & Payne, Electrical Engineers and Contractors, 39, Victoria-st, London, S.W.

Snape, H. Lloyd, D.Sc., Ph.D., Professor of Chemistry, University College, Aberystwith

*Snell, Albion T., Assoc.M.Inst.C.E., M.I.E.E., Consulting Electrical Engineer, Suffolk House, Cannon-st, E.C., and Brightside, Salusbury-rd, Brondesbury, N.W., London

Snell, J. F. C., Assistant Engineer St. Pancras Vestry, Electricity Department, Regent's Park Central Station, London, N.W.

Snowden, W. H., Electrician and Outside Works Manager, Messrs. Rashleigh Phipps & Co, 102, Oxford-st, London, W.

Snowdon, R., Mechanical and Electrical Engineer, Lake Vyrnwy, near Oswestry

Soames, A., Electrical Engineer, 16, Red Lion-st, Clerkenwell., E.C. (*Secohm London, 6770*)

SOCIÉTÉ D'EXPLOITATION DES CABLES ELECTRIQUES, Cortaillod, Switzerland. **See Advt., p. 8**

Société des Lunetiers, Electrical Apparatus Makers, 56, Hatton-gdn, London, E.C. (*Optical London, 6657*) (*See also* CONTINENTAL DIVISION)

Société Internationale des Électriciens (British Section), 47, Victoria-st, London, S.W. (R. Aylmer, M.Inst.C.E., Secretary and Treasurer) (*Leclanché London*)

Société Nouvelle, Limited, Makers of Glass Globes for Electrical Purposes, Union Bank Bldgs, Holborn, London, E.C.

Society of Arts (Society for Encouragement of Arts, Manufactures and Commerce), 18 and 19, John-st, Adelphi, London, W.C. (Sir Henry Trueman Wood, M.A., Secretary; H. B. Wheatley, F.S.A., Assist. Sec.) (*3110*)

Society of Arts Journal, 19, John-st, Adelphi, London, W.C. (Price 6d.)

Society of Chemical Industry, Palace-chmbrs, 9, Bridge-st, Westminster, London, S.W. (1894 Meeting in Edinburgh.)

E. C. C. Stanford ... ... President
Charles G. Cresswell ... ... Secretary

Society of Engineers, 17, Victoria-st, Westminster, London, S.W.

G. A. Goodwin ... ... President
Alfred Williams ... ... } Hon. Secretary and Treasurer
G. A. Pryce Cuxson, F.S.I. Secretary

Solomé, George F. de, Electrician, 17, Hanover-st, Islington, London, N.

Somers, R. M., Electrical Engineer, 15, Brudenell-rd, Hyde Park, Leeds

Somerville, G. J., District Manager, Telephone Company, Limited, Telephone Exchange, 102, Portland-st, Manchester

Sotheby & Ridout, Electrical Engineers, 124, Regent-st, London, W.

Sotheby, W. E., B.A., Electrician, 124, Regent-st, London, W.

South African Lighting Association, Limited, Gas and Electric Light Contractors, 90, Cannon-st, London, E.C. (W. Cash, Sec.)

See also page 296.

SOUTH AMERICAN CABLE COMPANY Limited, 106, Cannon-st, and 27, Royal Exchange, London, E.C.

Sir Charles Tupper, Bart., G.C.M.G., C.B. ... ... } Chairman
E. W. Parsone ... Manager and Secretary

See also page 296.

South, Harry, Engineer and Electric Light Contractor, 10 and 12, Garrick-st, Covent-gdn, and 61 and 62, High-st, Bloomsbury, London, W.C. (*Illucesco London*)

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Electrical Engineers and Contractors, Pump Pail, Croydon, and Cromwell Works, Croydon. (*Electric Croydon, 9386*)

South of England House-to-House Electricity Company, Limited, Richmond-rd, Earl's Court, London, S.W.

See also page 297.

South Staffordshire Electric Lighting Company, Limited, 33, Waterloo-st, Birmingham

See also page 297

South Staffordshire Tramways Company, Darlaston, Staffs. (A. Dickinson, Manager; H. Hatchett, Secretary)

See also page 297.

South Wales Brattice Cloth and India Rubber Company, Limited, 179, Dock-st, Newport, Mon. (*Canvas Newport, 160*)

South Wales Glass Manufacturing Co., Limited, Manufacturers of Glass Battery Jars, Crindau, Newport, Mon. (*Bottles Newport, 49*)

South-Western District and Thames Valley Electricity Supply Company, Limited, Battersea Foundry, Battersea, London, S.W.

See also page 297.

South Yorkshire Bottle Company, Manufacturers of Glass Battery Jars, &c., Swinton, near Rotherham (*Wilkinson Swinton Yorkshire*)

Southall Bros & Barclay, Manufacturers of Electrical Apparatus, Dalton-st, Birmingham

Southam & Co, Publishers of Electrical and Technical Publications, 28 to 30, Paternoster-row, London, E.C.

Southam, A. D., Electrical Engineer, 28 to 30, Paternoster-row, E.C., and 18, Redcliffe-st, Earl's Court, S.W., London

Southampton Electric Light and Power Company, Limited, 23, High-st, and Back of the Walls (*178*), Southampton

G. T. Harper, J.P.... Chairman
J. H. Lee ... ... Electrical Engineer
J. T. Hamilton ... Secretary (*36*)

See also page 297.

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Southey, James, Electrical Engineer, 43, King's-rd, Southsea

Southey, H. E., Electrical Engineer, 37, Crouch End-hill, London, N.

Southgate Engineering Company, Electrical and General Engineers, 172, Fenchurch-st, E.C., and New Southgate, N., London (G. Kimberley, Secretary). (*Centrifugal London*)

Soutter (Wm.) & Sons, Makers of Electric Light Fittings, Farm-st, Birmingham; and 47, Holborn-viaduct, London, E.C.

Soward, A. W., F.C.S., Electrician, 144, Friern-rd, East Dulwich, London, S.E.

Sowter, Wm. J., Electrical Engineer in Charge, County Asylum, Lancaster

*Spagnoletti, C. E. P. della D., M.I.C.E., Consulting Electrical Engineer to the Great Western Railway Company and to the City and South London Railway Company, Limited, and Managing Director of the Phonopore Company, Limited, Faraday House, Charing Cross-rd, London, W.C.

Spagnoletti, Hylton, Electrical Engineer and Local Representative of Messrs. J. B. Saunders and Co. Swansea

SPAGNOLETTI (J. E.) & CROOKES, Manufacturing Electricians and Contractors Goldhawk Works, 39B, Goldhawk-rd, London, W. (*Isolar London, 8747*)

Spain, H. G. G., Electrician, Talavera, St. Leonards-rd, Eastbourne

Spanish National Submarine Telegraph Company, Limited, 106, Cannon-st, London, E.C. (*Guanche London*)

Robert Kaye Gray ... ... Chairman
W. J. Tyler ... ... Secretary

See also page 297.

Spark, Alex., Electrician, 4, Belmont-st, Aberdeen

Speight, J. W., Electrician, Bradford Corporation Electricity Works, Bolton-rd, and 117, Thornton-rd, Bradford

Sparks, Charles Pratt, Electrical Engineer, 27, Charterhouse-sq, E.C., and Suffolk House, 5, Carmalt-gdns, Richmond-rd, Putney, S.W., London

Spear & Jackson, Manufacturers of Engineers' Tools, &c., Ætna Works, Sheffield; and 22, Queen-st, London, E.C. (*Spear Sheffield*)

Spence, Wilfrid L., Electrical Engineer, Assoc. M.Inst. C.E., The Elms, Seymour Grove, Manchester, S.W.

Spencer (Edward) and Co, Makers of the Macdonald Subway Electrical Conduits, 1, Aldgate, and (Works) Longfellow-rd, London, E. (*4317*)

Spencer (James) & Co, Makers of Overhead Travelling Cranes, Machine Tools, &c, Chamber Iron Works, Hollinwood, Manchester; and 5, Dowgate Hill, London, E.C. (*Spencer Hollinwood, Wynegar London.*)

Spencer, J. E. & S., Makers of Electric Light Wire Conduits, &c., 14, Great St. Thomas-apostle, and (Warehouse) 29, Bow-lane, Cannon-st, London, E.C.; and at Wednesbury. (*Tubes London, Tubes Wednesbury*)

Spencer, John, Iron Tube Manufactturer, Globe Tube Works, Wednesbury; 14, Great St. Thomas Apostle, London, E.C.; and 10, Dale-st. Liverpool. (*Tubes Wednesbury; Tubes London*)

Spencer (John) & Sons, Limited, Electric Welders, Newburn; and 139, Cannon-st, London, E.C.

Spencer, W. E. S. H., Electrician, Metropolitan Electric Supply Company, Limited, 17, South-st, Manchester-sq, London, W.

Sperling & Co, Agents for the Victoria Electric Railway and Lighting Company, Limited 8, Austin Friars, London, E.C.

Spiers, J. A., Electric Light Engineer, 12, Glebe-pl., Galashiels

Spokes, A., Electrical Engineer, Inventor of the Spokes Arc Lamp, Stenson's Works, St. James' End, Northampton.

Spon, E. & F. N., Technical Publishers, 125, Strand, London, W.C.

Spooner, A. F., Patent Agent, 124, Chancery-lane, London, W.C.

Spooner, H. J., Consulting Engineer, Director of the Polytechnic School of Engineering, 311, Regent st., London, W. (*1747*)

Sprague, J. T., Consulting Electrician, 117, Green-lane, Birmingham

Spratt Bros, Electrical Cabinet Work Manufacturers, Tudor Works, Tudor-rd, Hackney, London, N.E. (*Rhamnus London*)

Springett, F. S., Electrician, Ashfield, Hawkhurst, Kent

Square Drilling Machine Company, Limited, Manufacturers of Square and Angular Hole Drilling Machines, 23, Budge Row, London, E.C.

Squire, —, Maker of the "Star" Incandescent Lamp, 51, Leconfield-rd, Highbury, London, N.

Squire & Co, Electrical Engineers, South Molton, Devon.

Srawley, Browett & Co, Makers of Electric Light Fittings, Cellini Works, 116, Branston-st, Birmingham

*Stallibrass, Edward, A.M.Inst.C.E., Electrical Engineer and Electrician, c/o W. Sharpey Seaton, 57½, Old Broad-st, London, E.C.

Stanbury, A., Electrical and Mechanical Engineer, 2, Mount Vernon-rd, Liverpool

Standard Electrical Time Recording Company, Limited, 39, Victoria-st, London, S.W.

Standard Time Company, Limited, Electric Clock Makers, &c., 19 and 21, Queen Victoria-st, London, E.C. (E. Ray, Secretary)

See also page 297.

Stanger & Blount, Electro-Metallurgists, Chemical Laboratory and Testing Works, 2, Broadway, Westminster, S.W. (*3117*)

Stanley & Davies, Electrical Engineers, Makers of the Excelsior Dynamo, Hyde, near Manchester. (*Stanley Hyde*)

Stanley & Dawkins, Electricians, 8, Warstone Parade East, Birmingham

Stanley, W. F., Mathematical and Drawing Instrument Maker, 4 and 5, Great Turnstile, Holborn, W.C. (*2912*), and 8, Victoria-st, S.W., London. (*Turnstile London*)

Stansell & Son, Electric Light and Telephone Engineers, East-st and Billet-st, Taunton. (*Stansell Taunton*)

Stanton, F. & E., Drawers of Wire for Electrical Purposes, Lewisham, London, S.E. (*Arancolus London*)

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Stanton Iron Works Company, Limited, Makers of Cellular Channels for Electric Cables, 9, Bridge-st, Westminster, London, S.W.; and at Nottingham

Stanton, J. C. M., Electrical Engineer, 8, Duke-st, St. James's, London, S.W.

Staples, Henry J., A.I.E.E., Electrician, Spondon, Derby

STATTER (J. G.) & CO, Limited, Electrical and Mechanical Engineers and Contractors, Makers of the Statter Steam Engines, Dynamos and Motors, Switches, Switchboards, &c.: Head Office: 68, Victoria-st, London, S.W. Works: Cuba-st, Millwall, London, E. (Telegrams: *Statter London.* Telephone No. *3138.*) **See Advt., p. 471**

See also page 297.

*Statter, J. G., Electrical Engineer, 68, Victoria-st, London, S.W.

STATIST, THE, the leading Weekly Financial Journal. Editorial Offices: 20, Bucklersbury, London, E.C. Publishing Offices: Salisbury-ct, Fleet-st, London, E.C. Price 6d. (*Statist Newspaper London, 2714*) **See Advt., p. 200**

The most valuable financial information and guidance; first-class Advertising Medium. Annual subscription: U.K., £1. 8s.; abroad, £1. 10s.

Staveley, A. W., Manufacturing Electrician (Messrs. Gent & Co), Faraday Works, Leicester. (*Gents Electricians Leicester, 151*)

Staveley Coal and Iron Company, Limited, Makers of Conduits for Electric Wires, Staveley, Lancs.

Stead, Frank Villiers, Electrician, 44, Gutter-lane, London, E.C.

Steamship, The (monthly), devoted to Marine Engineering, Shipbuilding, and Ship Electric Lighting, 2, Custom House-chmbrs, Leith. Edited by John Lockie, C.E., Wh.Sch. (Price 6d.) (*Lockie Leith*)

Steble, Lt.-Col. R. F., Chairman of The Scarborough Electric Supply Company, Limited, Ramsdale Bank, Scarborough

Steedman, Thomas C., Limited, Chemical Manufacturers and Merchants, 2, 3, & 4, Robinson-row, Hull

Steel (P. B.) & Co, Electric Light Engineers and Contractors, Commercial-st, Dundee

Steel, R. Elliott, Electrician, 6, Woodside, Plymouth

Steel Company of Scotland, Limited, Manufacturers of Steel Plates, Bars, and Castings, 23, Royal Exchange-sq, Glasgow. (*Steel Glasgow*)

Steel, Dyne, Milnes & Co, Electrical Apparatus Makers, Exchange-bldgs, Swansea

Steel & Sons, Limited, Electro-Platers, 113, Royal-avenue, Belfast (*Electro Belfast, 695*)

Stegmann, G., Electrical Engineer and Contractor, 69, St. John's-hill, Clapham Junction, London, S.W.

Steiger, Alph., Consulting Turbine Engineer, 16, Mincing-lane, London, E.C.

Stennor & Co, Electrical and General Engineers, Tiverton, Devon

Stentor Telephone Mouth Piece Company, 23, Regent-sq, London, W.C. (Stephen Percy, Manager)

Stephen, Johnston, Electrician, Dunedin Cottage, Lasswade, Midlothian

Stephens, Joseph H., Electrical Engineer, 21, Alpha-rd, Millwall, London, E.

Stephens, Smith & Co, Electrical Engineers and Contractors, 1, Cuba-st, Millwall, London, E.

Stephens & Son, Makers of Electric Rock Drills, Carn Brea, Cornwall

Stephenson, Charles Arthur, Electrician, 90, Inverness-ter, London, W.

Stern Bros, Makers of Dynamo Oils, 57, Gracechurch-st, London, E.C. (*Centumvir London*)

Sterne (L.) & Co, Limited, Makers of the Clerk Gas Engine, Crown Iron Works, 156, North Woodside-rd, Glasgow; and at London (*Crown Glasgow; Elsterne London, 3066*)

Stevens (Jas.) & Son, Manufacturers of Electric Globes and Miners' Safety Lamps, Victoria Glass Works, Dartmouth-st, Birmingham. (*Lense Birmingham*)

Stevens (J.) & Co, Electrical Engineers, High-st and George-st, Romford. (*Stevens & Co Romford*)

Stevens, Robert, Electrician and Ivory Turner, 10½, Baron-st, Pentonville, London, N.

Stevens, W. A., Lecturer on Magnetism and Electricity (S. Kensington), 45, Hastings-rd, Maidstone

Stevenson, Chas., F.R.S., Electrical Engineer, 84, George-st, Edinburgh

Stevenson & Cowper, Electrical Engineers and Contractors, Middlesborough

Stevenson & Davies, Engineers and Boiler Makers, 11, Queen Victoria-st, London, E.C. (*Quetta London, 15007*)

Stevenson, Ed. Alf., Electrician, Telegraph Construction and Maintenance Company, Limited, Enderby's Wharf, East Greenwich, London, S.E.

Stevenson, George, Eastern Telegraph Company, Winchester House, 50, Old Broad-st, London, E.C.

Stevenson, H., Engineer, Hove Electric Lighting Company, Limited, Hove, Sussex

Stevenson, James, C.E., Patent Agent, Gray's Inn-chmbrs, 20, High Holborn, London, W.C. (*Sagittarius London*)

Stevenson, W., Telegraph Engineer, Telegraph Department, Caledonian Railway, Glasgow

Stevenson, William Henry, Electrician, 61, Vicarage-road, Willesden, London, N.W.

Stewart, A. W., Electrical Engineer, The Crescent, Dalmuir, nr Glasgow.

Stewart, A. W., Electrician, 73, Vanbrugh-park, Blackheath, London, S.E.

Stewart (A. & J.) & Clydesdale, Limited, Manufacturers of Smooth-bore Tubes for Electric Mains, Poles, Flanged Iron and Steel Steam Tubes and Connections, Lapwelded Boiler Tubes, &c., 41, Oswald-st, Glasgow; and Clyde Tube Works, Coatbridge; and 35, Queen Victoria-st, London, E.C. (*Lapweld Glasgow; Stewart Coatbridge; Lapweld London, 1893*)

Stewart (D.) & Co, Limited, Manufacturers of Electric Light Apparatus, Loudon-rd Iron Works, Glasgow; and 122, Cannon-st, London, E.C. (J. Lindsay, Secretary) (*Stewart Glasgow; Operameter London*)

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Stewart D., Assistant Superintending Engineer, Postal Telegraphs, Glasgow

Stewart, J. E., Electrical Engineer, Corporation Electric Light Station, Fult-st, and "Melrose," Trowel's-lane, Derby. (*Electric Derby, 237*)

Stewart, R. D , Chemical Manufacturer, 61 and 62, Tenter-st, Goodman's Fields, London, E. (*Odorless London*)

Stewart, S., Electrical Engineer in Charge Greenock Central Electric Lighting Station, Prospect-hill, Greenock

Stewart (T.) & Sons, Electric Bell Fitters, Cross, Kilmarnock. (*Stewart Kilmarnock*)

Stiepel (E.) & Co, Agent for Electricals Supplies, 8, Union-ct, Old Broad-st, London, E.C.

STIFF (J.) & SONS, Porous Cell and Plate, Battery Jar, and Insulator Makers, London Pottery, Lambeth, S.E. (*Stiff London, 4627*) **See Advt., p. 579**

Stiffin & Co, Makers of Models, Screws, Nuts, &c, 51, Roding-rd, Homerton, London, N.E.

Still, Percy, Engineer Chelsea Electricity Supply Company, Limited, Draycott-pl, Cadogan-gdns, Chelsea, London, S.W. (*Still c/o Economy London*)

Still (W. M.) & Co, Metal Spinners, 24, Charles st, Hatton-gdn, London, E.C. (*Metal Spinner London, 6718*)

Stobbs, Wilson & Pollard, Agents for Geo. G. Blackwell, Sons, & Co, 12, Billiter-bldgs, E.C., and Bridge Dock Wharf, Narrow-st, E., London (*Barytes London*)

Stockdale, Lawson, Telegraph Engineer, Telegraph Department, L. & N. W. Railway Company, Preston, Lancs.

Stocker & Co, Manufacturing and Export Electricians, 83, Upper Thames-st, London, E.C.; and at Leipzig, Hamburg, and Cologne.

Stockley, H. R., Electrical Engineers, Calder Ironworks, Coatbridge.

Stockman & Doyle, Civil and Electrical Engineers, 3, Poet's-corner, Westminster, London, S.W.

Stockton Forge (The), Mechanical, Engineers, &c., Stockton-on-Tees; and 5, Laurence Pountney-hill, Cannon-st, London, E.C. (*Forge Stockton-on-Tees; Ferric London*)

Stockwell, P. H., 2nd Class Technical Officer General Post Office, London, E.C.

Stoecker (C.) & Co, Makers of Electric Light Fittings, 45, Jewin-st, London, E.C. (*Pumice London*)

Stokes (A.) & Co, Manufacturers of Brass and Copper Screws, &c, Green-st, Deritend, Birmingham

Stokes, Sir George Gabriel, Bart., D.C.L., LL.D., Sc.D., F.R.S., Lucasian Professor of Mathematics in the University of Cambridge, Lensfield Cottage, Cambridge

Stokes, Sydney, Electrician, 22, Combe-ter, Blackheath, London, S.E.

Stokes, W. F., Electric Light Engineer, 51, Picton-st, Exmouth

Stone, Fawdry & Stone, Manufacturers of Finest Cut Glass for Electric Light Shades in all colours, Union Glass Works, Birmingham. (*Retorts Birmingham*)

Stone (J.) & Co, Anti-Friction Metal Makers, Deptford, London, S.E. (*Stone Deptford London, 8002*)

Stone, William, Scientific Instrument Maker, 41, Gloucester-street, Bloomsbury, London, W.C.

Stoney, Gerald, B.A., M.I.E.E., Electrician, 90, Meldon-terrace, Heaton, Newcastle-on-Tyne.

Storey (Isaac) & Sons, Engineers and Coppersmiths, Knott Mill, Little Peter-st, and Cornbrook, Manchester. (*Stork Manchester*)

Storey (Joseph) & Co, Manufacturing Chemists, Heron Chemical Works, Lancaster. (*Heron Lancaster*)

Stotherd, L. H. K., Electrical Engineer, 23, Wellington-rd, Charlton, London, S.E.

Stotherd, R. H., Major-General R.E., C.B., M.I.E.E., Heathcote, Camberley, Surrey

Stothert, J. K., B.A., Electrician, Faraday House, Charing Cross-rd, London, W.C.; and 62, Rawson-rd, Seaforth, Liverpool

Stothert & Pitt, Limited, Electric Crane Makers and General Engineers, Bath; and 30, Walbrook, London, E.C. (*Stothert Bath; Stothert London*)

Stott & Sons, Consulting Engineers and Electric Light Contractors, 60, Hawarth's-bldgs, and 5, Cross-st, Manchester.

Straker & Whitworth, Consulting Engineers, 139, Cannon-st, London, E.C.

Straube, Albert A. L., Electrical Engineer, 12, Queen Anne's-gate, Westminster, London, S.W.

STRAUS, G., Sole Representative of the Hamburg Incandescence Lamp Co. for the sale of the "Venus" Glow Lamps, 130, Queen Victoria-st, London, E.C. (*Merriness London.*) **See Advt., p. 8.** (*See also* Electricitäts Gesellschaft in CONTINENTAL DIVISION).

Street, S. Probart, Electrical Engineer, 21, Great College-st, Westminster, S.W., and 5, Serle-st, Lincoln's-inn Fields, W.C., London

Strick, J., Electrical Engineer, Kerbey Bowen, Limited, 55, Regent-st, London, W.

Stringer, E. B., Electrician, 101, St. Martin's-lane, Charing-cross, London, W.C.

Strode & Co, Electric Light Engineers, &c., 48, Osnaburgh-st, N.W. (*3807*), 188, Piccadilly, W. (*3958*), and 67, St. Paul's-churchyard, E.C., (*441*) London. (*Strodes London*)

Strode, W. W., Electrical Engineer, 48, Osnaburgh-st, Regent's-park, London, N.W. (*Strodes London, 3807*)

Stroh, Augustus, M.I.E.E., Electrician, 98, Haverstock-hill, London, N.W.

*Stroud, Prof. H., M.A., D.Sc., Professor of Physics, Durham College of Science, Newcastle-on-Tyne

*Stroud, Prof. W., M.A., D.Sc., Professor of Physics, Yorkshire College, Leeds

Stuart, A. M., Capt. R.E., Brompton Barracks, Chatham

Stuart, C. E., Controller of Stores, Postal Telegraphs, Telegraph-st. London, E.C.

Stuart, Frank E., A.I.E.E., C.E., Fire Brigade Electrician Expert in Fire Telegraphs, Volthurst, Twickenham (*Stuart Electrician Twickenham*).

Stuart-Menteath, Edward Thorold, Electrical Engineer, Hampden Club, Phœnix-st, St. Pancras, London, N.W.

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Stubbs, Arthur J., Technical Officer, Engineer-in-Chief's Office, General Post Office, London, E.C.

Sturm, Frederick W., Agent for the Naxos Union, 23, Crutched-friars, London, E.C.

STURTEVANT, T. T., Electro-plate Manufacturer, St. John's Works, 92, Clerkenwell-rd, London, E.C. **See Advt., p. 596**

Silver and Nickel Plating and Metal Polishing and Lacquering for the Trade

SUBMARINE CABLES TRUST, Winchester House, Old Broad-st, London, E.C. (Hon. A. Brodrick, Secretary)

See also page 297.

Sudron (T.) & Co, Limited, Makers of Telegraph Poles and Masts, 9, Duckfoot-lane, London, E.C.; and Imperial Boiler Works, Stockton-on-Tees

Sugden, James, Consulting Electrical Engineer, 3, Belmont-villas, Rye-rd, Peckham, London, S.E.

Sugg (Wm.) & Co., Limited, Electrolier Manufacturers, 1 and 2, Grand Hotel-bldgs, Charing Cross, W.C., 1A, Ludgate-hill, E.C., and 65-73, Regency-st, S.W., London,

Sullivan, Herbert W., Telegraph Engineer, 29, Ladbroke-sq, London, W.

Summerling & Co., Limited, Dynamo Nickel Platers, Coppersmiths, &c., 63, Bunhill-row, and 145, Old-st, London, E.C. (*Summerling London*)

*Sumpner, W. E., D.Sc., Electrical Engineer, Director of the Electrical Department, Battersea Polytechnic, Battersea, London, S.W.

Sunbeam Lamp Company, Limited, Sole Makers of the Sunbeam Incandescent Lamp, Park-rd, Gateshead-on-Tyne; and 50, Fenchurch-st, London, E.C. (T. J. Grainger, Secretary.) (*Sunbeam Gateshead, 138; Cyclops London, 4251*)

See also page 297.

Sunderland (J.) & Co, Electrical Engineers, Victoria Electrical Works, 183, Gibbet-st, Halifax. (*Sunderland Halifax*)

SURVEYORS TO LOCAL AUTHORITIES—*see pages 234 to 252*

Sutcliffe Bros,, Belting, Grease and Cement Makers for Covering Boilers, &c., Globe Works, Godley, Manchester. (*Sutcliffe Hyde*)

Sutcliffe, J. T., Electrical Engineer and Manufacturing Electrician, Ohm Electrical Works, 153, South-st, Sheffield

Suter (Frank) & Co, Electrical Engineers and Contractors, 66, Berners-st, London, W. (*35203*)

Suter, Sidney J., Electrical Engineer, 22, Bickerton-rd, Junction-rd, London, N.W.

SUTHERLAND, MALCOLM, M.I.E.E., Consulting Engineer and Electrician, 3, Royal Exchange-court, Glasgow

Sutton, G., Managing Director, W. T. Henley's Telegraph Works Company, Limited, 27, Martin's-lane, Cannon-st, London, E.C. (*Henley's Works London, 1734*)

Sutton, William, Electric Bell Fitter, Wollaton-st, Nottingham

Sutton's Process Syndicate, Limited, Electro-phototypers, &c., 4, Tokenhouse-bldgs, London, E.C.

Swain, Geo., Electric Bell Fitter and Ventilating Engineer, 194, Plumb-lane, Bradford (*4668*)

Swain (John) and Son, Draughtsmen and Engravers, 266, Strand, W.C., and 58, Farringdon-st, E.C., London

Swan Electric Engraving Company, Electric Engravers, 116, Charing Cross-rd, London, W.C.

*Swan, Joseph W., Electrical Engineer, Lauriston, Bromley, Kent

Swan United Electric Light Company, Limited, 100, Victoria-st, London, S.W. Factory: 11, Mittelstrasse, Kalk bei Cologne, Germany. (*Swanuni London*)

J. S. Forbes ... ... Chairman
H. Charles Gover ... Secretary & Manager

See also page 297.

Swann, G., Electrician, 33a, Earl's Court-rd, Kensington, London, S.W.

Sweet, Andrew, Chairman of Electricity Committee, St. Pancras Vestry Hall, St. Pancras, London, N.W.

Sweet Bros., Dealers in Electrical Supplies, 102, Hampstead-rd, London, N.W.

Swete, Oswald R., A.I.E.E., Electrician, Fort Royal, Worcester. (*Oswald Swete Worcester*)

Swift (J.) & Son, Scientific Instrument Makers, University Optical Works, 81, Tottenham Court-rd, London, W.

SWINBURNE & CO, Limited, Electrical Engineers, Broom Hall Works, Teddington. (*Swinburne Teddington*) **See Advt., p. 637**

See also page 297.

*Swinburne, J., Electrical Engineer, 4, Hatherley-rd, Kew-gdns, London, S.W.

Swindells, Vincent, Electrician and N. of England Representative, Fowler-Waring Cables Co., Limited, 102, Portland-st, Manchester

SWINTON (A. A. C. & CO.), Electrical Engineers and Contractors, 66, Victoria-st, London, S.W. (*Dunamis London 3156*)

*Swinton, A. A. C., Consulting Electrician and Electrical Engineer, 66, Victoria-st, London, S.W. (*Dunamis London, 3156*)

Swithinbank, J. W., A.I.E.E., Telephone Engineer, Local Manager National Telephone Company, Commercial-bldgs, Leeds. (*1*)

Sydney & Barnet, Electrical Apparatus Makers, 38, Walham-grove, London, S.W.

Sykes, Alfred, Manufacturing Electrical Engineer, 74, Fitzwilliam-st, Turnbridge, Huddersfield

Sykes, Henry, Engineer and Dealer in Electric Lighting Plant, 66, Bankside, London, S.E.

Sykes (Joseph) Bros. Limited, Mechanical and Electrical Engineers, Acre Mills, Lindley, Huddersfield. (*Sykes Lindley, 79*)

Sykes, W. R., Manufacturer of the Sykes Lock and Block Railway Signalling Apparatus, Station-rd, High-st, Clapham, London, S.W.

Symes & Co, Limited, Dealers in Electrical and Chemical Apparatus, 14, Hardmann-st, Liverpool. (*Symes Liverpool, 1023*)

Symons, G. J., F.R.S., Secretary of the Royal Meteorological Society, 62, Camden-sq, London, N.W.

Syndicate of Electrical Engineers, 15, St. Helen's-pl, London, E.C. (P. A. Latham, Secretary)

See also page 297.

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Szerelmey (N. C.) & Co, Manufacturers of the Szerelmey Iron Paint, 277, Rotherhithe New-rd, London, S.E. (*Szerelmey London*)

— T —

Tait, Peter G., D.Sc., Professor of Natural Philosophy, University of Edinburgh

Tait, R. J., Electrician, Telephone and Electric Light Engineer, Chester-le-Street, Durham

Takata & Co, Contractors for General and Electrical Machinery, 88, Bishopsgate-st Within, London, E.C. (*Takata London*) (*See also* CONTINENTAL DIVISION)

Talbot, Ernest, Electrical Engineer, 5, Victoria-st, London, S.W.

Talbot, H., Borough Electrical Engineer, Central Electric Light Station, Nottingham

Talbot, Oswald, Electrician, High-st, Mortlake, London, S.W.

Talbot, Robert, Electrician, 204, Gorton-lane, Gorton, Manchester

Tallis, John Fox, Electrical Engineer, The Firs, Ebbw Vale, Mon.

Tandy, Frank, Electrician, Llanfairpwllgyngll, Anglesey, North Wales.

TANNAHILL (A.) & Co., Mica Merchants, 21, Mincing-lane, London, E.C.

Tangyes Limited, High-Speed Steam and Gas Engine Makers, Cornwall Works, Birmingham; and at London, Newcastle-on-Tyne, Manchester, and Glasgow. (*Tangyes Birmingham; Tangyes London, 1625*)

Tangyes Machine Tool Company, Limited, Oxford Works, Birmingham; and 35, Queen Victoria-st, London, E.C. (*Tangyes Birmingham*)

Tarbutt & Quentin, Civil Engineers, 23, St. Swithin's-lane, London, E.C. (*Tarbutt London, 1526*)

Tasker, Ernest A., Electrical Engineer, 4, Dean-st, St. Paul's, Bristol.

Tasker, John, Electrical Engineer, Crooke's House, Sheffield

Tasker, P. S., Electrician, 12, Pembroke-rd, Kensington, London, W.

Tasker, Sons & Co, Manufacturers of India Rubber and Leather Driving Bands, and Gutta Percha Manufacturers, &c., (Works), 32, Angel-st, and (Engineering Depôt) New Station-rd, Sheffield. (*Tasker Sheffield, 8—10*)

Tasker, W. Howard, M.I.E.E., Consulting Electrical Engineer, 12, Pembroke-rd, Kensington, London, W.

Tate, L. G., Electrician, 1, York-villas, Hill Rise, Richmond, Surrey

Tatham, Sydney B., Electrical Engineer, 16, Davies-st, Berkeley-sq, London, W.

Tatlock (R. R.) & Readman, Electricians and Consulting Chemists, 4, Lindsay-pl, George IV. Bridge, Edinburgh. (*Readman Edinburgh*)

Tatlow, W., Electrical Engineer, 7, Belgrave-sq, W.; and Monkstown, Dublin

Taunton Electric Lighting Company, Limited—*in liquidation*. (A. Goodman and William James Villar, Taunton, Liquidators)

Tayler Smith Electric Company, Limited, Electrical Engineers, Contractors for Electric Lighting, and Manufacturers of Electrical Apparatus, 53, South Molton-st, Oxford-st, London, W. (*Deserving London*)
See also page 297.

Tayler Smith, T., Consulting Electrical Engineer and Electrician, 53, South Molton-st, Oxford-st, London, W.

Tayler (D. F.) & Co, Limited, Wire Manufacturers, New Hall Works, George-st, Birmingham. (*Epingles Birmingham*)

Taylor, A., Electrician, 266, Halifax-rd, Rochdale, Lanca.

Taylor, A. Lester, Telegraph and Electric Light Engineer, Prudential-bldgs, 36, Dale-st, Liverpool

Taylor, A. M., Electrical Engineer, Conduit Lodge, Blackheath-park, London, S.E.

Taylor Bros. & Co, Engineers, Manufacturers of Castings, Forgings, &c., Clarence Iron and Steel Works, Leeds; and 16, Victoria-st, Westminster, London, S.W. (*Taylors Leeds, 539*)

Taylor Bros., Electrolier, Lamp, Lustre, &c., Manufacturers, Cooksey-rd, Small Heath, Birmingham (*Chandelier Birmingham*)

Taylor & Challen, Limited, Mechanical and Electrical Engineers, Derwent Foundry, Constitutional Hill, Birmingham. (*Derwent Birmingham*)

Taylor, Charles, Lathe Maker, Bartholomew-st, Birmingham (*Lathes Birmingham, 401*)

Taylor & Co, Makers of Tools for Electricians, 247, Moston-lane, Blackley, Manchester

Taylor & Co, Mica Merchants, 19, Hatton-gdn, London, E.C. (*Micaylor London*)

Taylor, C. Purcell, D.Sc., Electrical Engineer and Patent Expert, c/o Mrs. Robertson, 82, High-st, Dundee

Taylor, Davison, Electrician, 11, Borough-rd, Sunderland

Taylor, E. D., Dealer in Electric Light Fittings, 145, Great Charles-st, Birmingham

Taylor, F., Assistant Superintendent Eastern Telegraph Co., Porthcurnow, Treen, R.S.O., Cornwall

Taylor, Frederic H., Electrical Engineer, "Kenwyn," 14, Darenth-rd, Stamford-hill, London, W.

Taylor, G. Crosland, Electrical Telegraph Engineer and Consulting Machinist, Britannia Telegraph Works, Helsby, near Warrington. (*Limited Helsby*)

Taylor, G. E., Electrical Engineer, Southampton Harbour Board, Southampton

Taylor, Herbert, M.I.C.E., Telegraph Engineer, 4, Great Winchester-st, London, E.C.

Taylor, H. A., Electrical Engineer, 25, Collingham-rd, South Kensington, London, S.W.

Taylor, H. E. I., Electrician, The Larches, Banstead, Surrey

Taylor, H. J., Electrician, Ivy Cottage, Queen's-rd, Thames Ditton

Taylor, James, Chairman Telegraph Manufacturing Company, Helsby, near Warrington. (*Limited Helsby*)

Taylor (James) & Son, Manufacturing Electricians and Telephone Fitters, West-st, Ilminster, Somerset

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Taylor (J.) & Co, Electric Bell Manufacturers, Loughborough

Taylor, J. E., Telegraph Engineer, Post Office Telegraph Instrument Factory, Bovay-pl, Holloway, London, N.

Taylor, Joseph, Designer and Manufacturer of Electroliers, 42, Lamb's Conduit-st, Theobald's-rd, London, W.C.

Taylor & Parsons, Manufacturing Electricians, Bank-st, Bradford

Taylor, Robert, Electrician, 5, Taylor-place, Abbey-hill, Edinburgh

Taylor, Taylor & Hobson, Engraving Machine Makers, Slate-street, Leicester; and 6, Southampton-street, High Holborn, London, W.C. (*Lenses Leicester, 134; Illiquo London*)

Taylor & Tucker, Art Metal Company, Limited, Art Smiths, &c., 9, Duke-st-mansions, Grosvenor-sq, W., and Winchelsea-rd, Harlesden, N.W., London.

See also page 298.

TAYLOR, TUNNICLIFF & CO, Makers of China Roses and Pushes for Electric Bells, Eastwood, Hanley; and 47, Holborn-viaduct, London, E.C. (*Eastwood Hanley, 12*)

See Advt., p. 485

Taylor, W., Electrician, 33, Treherne-rd, Brixton, London, S.W.

TAYLOR, W. F., Consulting Electrical and Mechanical Engineer, Boswell Court, Croydon

TAYLOR (W. F.) & CO, Electrical Engineers, Harrow-on-the-Hill

Taylor, William, Electrician, 17, Bishop-st, Dublin

Taylor, Wm., Electrician, 4, Dillon-place, Hornsey-rd, Holloway, London, N.

Teague, Francis, Resident Engineer of the Scottish House-to-House Electricity Company's Works, Coatbridge, N.B.

Technic Manufacturing Company, Manufacturers of Electrical Apparatus, Aston, Birmingham

Technical World (weekly), 14, Langham-pl, London, W.

Technical Association of London Metallurgists, Electrical and Mechanical Engineers, 13, Golden-sq, London, W.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, Limited, Submarine Cable Makers, &c., 38, Old Broad-st, E.C.; Morden & Enderby's Wharves, East Greenwich, S.E.; and Wharf-rd, City-rd, N., London. (*Telcon London*)

Adml. Sir G. H. Richards, K.C.B. Chairman
William Shuter ... ... Managing Director
E. Dickens... ... ... Secretary

See also page 298.

Telegraph Improvement Company, Limited, Makers of the Allan-Brown Patent Relays for Submarine Cables, 10, Austinfriars, London, E.C.

Telegraph Journal (twice a month), 1, Nelson-ter, Philip-lane, Tottenham, London, N. (A. W. Morris, Editor). (Price 2d.)

TELEGRAPHIC COMMUNICATION THROUGHOUT THE WORLD, INFORMATION CONCERNING—*see pages 208 to 210*

TELEGRAPH MANUFACTURING COMPANY, Limited, Manufacturers of Insulated Wires and Cables of every description, Lamps and Fittings, Insulators, Batteries, Ironwork, Instruments, Switchboards, &c., Britannia Works, Helsby, near Warrington (*Limited Helsby*). Branch Offices: 11, Queen Victoria-st, London, E.C. (C. E. Wetton, Agent—*Concentric London, 1935*); 16, Newington, Liverpool (*Instrument Liverpool, 1991*); and 30, Hope-st, Glasgow (*Thorough Glasgow*)

James Taylor ... ...
Geo. C. Taylor ... ... Directors
Fredk. Whiteley ... ...
Alfred Whalley, Electrical Engineer & Secretary

See also page 298.

Telegraphists' School of Science, Central Telegraph Office, St. Martin's-le-Grand, London, E.C. (W. Slingo, Principal; A. Brooker, Instructor in Electrical Engineering)

Telephone Company of Austria, Limited—*in voluntary liquidation, the Company's Exchanges having been taken over by the Austrian Government, as from Jan. 1, 1893*

Telephone Company of Egypt, Limited, 14, Austinfriars, London, E.C. (*Oakenpin London, 1367*)

General A. Fraser, C.B. ... ... Chairman
A. B. Chalmers ... ... Secretary

See also page 298.

Telephone Company of Ireland, Limited—*in liquidation, the business of the Company having been taken over by the* National Telephone Company, Limited (*q.v.*)

Temple (R.) & Crook (F.), Electric Light Engineers and Bell Fitters, 6, Motcomb-st, Belgrave-sq, London, S.W.

Terrey, Charles A., Electrical Engineer and Patentee, 114, Lambeth-rd, London, S.E.

Terrey, E. F., Electrician, 76, Royal-rd, Camberwell, London, S.E.

Terry, Stephen H. A., M.I.C.E., Electrical Engineer, Messrs. Bumsted and Chandler, 17, Victoria-st, London, S.W. (*Crankpin London, 3075*)

Tester (Malcolm) & Co, Manufacturers and Fitters of Pneumatic and Electric Bells, 28, Womersley-rd, Crouch Hill, London, N.

Tester, J. F., Electrician, 81, St. Dunstan's-rd, Hammersmith, London, W.

Tett, Henry S., Electrician and Ironmonger, Market-st, Faversham, Kent. (Agent for Messrs. J. D. F. Andrews & Co)

Thames Bank Iron Company, Engineers, Makers of Cast-Iron Pipes, &c., Upper Ground-st, London, S.E. (*Hot Water London, 4763*)

Thames Conservancy, 41, Trinity-sq, London, E.C. (*For Officials, see page 233*)

Thames Electric and Steam Launch Company, Electric and Steam Launch Builders, Eel Pie Island, Twickenham, London, S.W. (W. S. Sargeant, Manager)

THAMES IRONWORKS AND SHIPBUILDING COMPANY, Limited, Shipbuilders, and Civil, Mechanical, Marine and Electrical Engineers, Orchard-yd, (*5048*), and Dry Docks, Victoria Docks (*5087*), Blackwall, London, E. (J. H. Worsfold, Secretary). (*Thames London*) **See Advt. inside back cover.**

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Thatcher & Devereux, Patentees of Electric Signalling Apparatus, 15, Chivalry-rd, Battersea, London, S.W.

Theerman, William Paul, Electrician, 11, Great Ducie-st, Strangeways, Manchester

Theobald (J.) & Co, Scientific Apparatus Manufacturers, 19, Farringdon-rd, E.C. (*6767*), and 20, Church-st, Kensington, W. (*8597*), London

Theiler (M.) & Sons—*amalgamated with* Elliott Bros. (*q.v.*)

Thetford Electric Light and Power Company, Limited, St. Nicholas-st, Thetford, Norfolk (R. Carter, Secretary)

See also page 298

Thomas, Bertram, Electrician, 1, Springbank, Langham-rd, Bowdon, Cheshire

Thomas, —, Electrician and Patent Agent, 7, Mansford-st, Hackney-rd, London, N.E.

Thomas-Davies, G., Electrical Engineer, Tylagwyn, Pontllanfraith, Newport, Mon.

Thomas & Taylor, Electric Light Engineers and Contractors, 80 and 82, Lower Hillgate, Stockport; and 99 and 101, Fonthill-rd, Finsbury Park, London, N. (*Laundry Stockport*)

Thomas (Thos.) & Sons, Makers of Electric Elevators, Acme Hoist Works, Cardiff, and 141, Queen Victoria-st, London, E.C.

Thompson, Alfred, M.I.E.E., Electrician, 2, Fenchurch-avenue, London, E.C.

Thompson Bros, Boiler Makers, Bradley Boiler Works, Bilston; and 9, Ducksfoot-lane, London, E.C. (*Thompson Brothers Bilston*)

Thompson, C., Consulting Engineer, 33, Mosley-st, Newcastle-on-Tyne

Thompson (James & George), Limited, General and Electrical Engineers and Shipbuilders, Clydebank, near Glasgow

Thompson, John, Engineer and Boiler Maker, Ettingshall, Wolverhampton; and 73, Queen Victoria-st, London, E.C. (*Boiler Wolverhampton*)

Thompson (John) & Son, Consulting Engineers, 12, London-st, London, E.C.

*THOMPSON, N. G. (late Thompson & Rew), Electric Light Engineer and Contractor, 13, Victoria-st, London, S.W. **See Advt., p. 13**

Thompson, R., Electrical Engineer, 24, Highfield-cres, Rockferry, Chester

Thompson (R. B.) & Co, Makers of Glass Globes, Cells, &c., 45, East Howard-st, Glasgow.

Thompson, R. D., Consulting Electrical Engineer, Boarshaw, Middleton, near Manchester

Thompson, Ritchie & Co, Limited, Electrical and General Engineers, 48, James-st, Buckingham-gate, London, S.W. (*Farad London, 3208*)

See also page 298

Thomson (Robert) & Sons, Constructors and Repairers of Steam and Sailing Vessels, Southwick-yd (*Jet Sunderland*), and Bridge Dockyard, Sunderland (*Dockyard Sunderland.*)

*Thompson, Prof. Silvanus P., B.A., D.Sc., F.R.S., M.I.E.E., Professor of Physics, Morland, Chislett-rd, West Hampstead, London, N.W. (Principal of the City and Guilds Technical College, Leonard-st, City-rd, Finsbury, London, E.C.)

Thompson, W., Electrical Engineer, Gas Department, Municipal Offices, Victoria-st, Blackburn, Lancs.

Thompson, W., Engineer and Electrician, Cromptou Fold, Shaw, near Oldham

Thompson (W. P.) & Co, Electrical Patent Agents, 6, Lord-st, Liverpool; 6, Bank-st, Manchester; and at Birmingham, Nottingham, and London. (*Patents Liverpool, 696; Owden Manchester*)

Thompson, E., Electrician, 10, Marlborough-rd, Lee, London, S.E.

Thomson (Archibald) & Co, Makers of the "Hercules" Driving Ropes, 58, Howard-st, and Glasgow Rope Works, Glasgow; and at Shettleston. (*Thomson Glasgow. 548*)

Thomson, C. S., M.Sc., Electrical Engineer, 98, Amity-grove, Cottenham Park, Wimbledon, London, S.W.

Thomson, E., Telegraph Engineer, 5, Featherstone-bldgs, Holborn, London, W.C.

Thomson-Houston International Electric Company, Electric Railway and Tramway Contarctors, 35, Parliament-st, S.W., and 79, Mark-lane, E.C., London (W. S. Graff Baker, Manager) (*Carwheel London*)

*Thomson, J. J., M.A., F.R.S., Cavendish Professor of Experimental Physics, The University, and 6, Scrope-ter, Cambridge

Thomson, Jocelyn H., Electrical Engineer, 18, Draycott-pl, London, S.W.

Thomson, J. L., Electrician, 57, Eglington-st, Ardrossan

Thomson, Son & Co, Turbine Manufacturers, Dundee (*Turbine Dundee*)

Thornebury Miners' Safety Lamp Company, Limited—*in liquidation*. (F. Newton, 9, Warrington-cres, Maida Vale, London, W., Liquidator)

Thornton, A. G., Manufacturer of Scientific Instruments, 101, Deansgate, Manchester. (*Drawing Manchester*)

Thornton, E., Electrical Engineer, 37, Stafford-st, Barrow-in-Furness (*Thornton Barrow, 38*)

Thornton, G. H., Electrician, 133, Charlton-lane, Charlton, Kent

Thornton, Robert, Maker of Staples for Telegraph Wire, Cleckheaton, Yorks

Thornycroft (J. I.) & Co, Makers of Steam Engines for Electric Lighting, Chiswick, London, W. (*Thornycroft London, 8555*)

Thorpe, H., Electrical Engineer, 59, Theobald's-rd, and 34, Eagle-st, Red Lion-sq, London, W.C.

Thorrowgood, W. J., Consulting Electrician and Electro-Metallurgist, 129, Gladstone-rd, Wimbledon

Thurkle & Co, Manufacturing Electricians, 22, Denmark-st, Soho, London, W.C.

Thursfield, Francis, B.A., Borough Electrical Engineer, Electric Lighting Station, Aqueduct-st, Burnley

THWAITE, B. H., C.E., Consulting Engineer, 95, Finsbury-pavement, London

Thwaites Bros, Limited, General Engineers, Bradford, Yorks. (*Thwaites Bradford*)

Thwaites, James, A.I.E.E., Electrician, 25, St. John-st-rd, Clerkenwell, London, E.C.

Ticehurst, F. G., Telegraph Engineer, Langton House, Battle, Sussex

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Tickner & Partington, Electrical Engineers, Vulcan Works, Kensal Rise, N.W., and at Lower Tottenham, N., London

Tidd, Ernest George, Manager for Paterson & Cooper's Ship Lighting and Scotch Branches, 137, West Regent-st, Glasgow; and 9, Maritime-bldgs, Dundee. (*Patella Glasgow*)

Tiffin, F. J., Maker of Electric Light Fittings, 3, Great Winchester-st, London, E.C.

Tight, Charles, Telegraph Instrument Case Maker, 12, Percival-st, London, E.C.

Tilden, Dr. W. A., Professor of Chemistry, Mason's College, Birmingham.

Tillyer, E. G., Electrician, Engineer's Department, Exchange Telegraph Co, Limited, 17 and 18, Cornhill, London, E.C.

Timmis, Illius A., M.Inst.C.E., M.I.E.E., 2, Great George-st, Westminster, London, S.W. (*Timmis London*)

Timms, T., Slate Turner for Electrical Purposes, 21, Great Ormond-st, Queen-sq, London, W.C.

Tippett, James, Electrician, 1, Tregolls-ter, Truro

Tipping, Henry, Agent for the Excelsior Wick Carbon, 80, Queen Victoria-st, London, E.C.

Tittensor, Walter H., Assistant City Electrical Engineer, Dudhope Crescent-rd, Dundee

Titley & Crowdy, Electrical Engineers, Old Croft, Blunsdon, Highworth, Wilts

Todd, F. L., Electrical Engineer, Occold Rectory, Eye, Suffolk

Todd, John, Electrical Engineer, 82, Turnmill-st, London, E.C.

Todd, R. R., Electrician, 3, Abbey-rd, St. John's Wood, London, N.W.

Todhunter, William, Electrician, Enderby's Wharf, East Greenwich, London, S.E.

Todman, J. Torr, Electrical Engineer and Electrical Apparatus Maker, 36, Bermondsey-st, London, S.E.

Tolch & Co, Makers of Oil Engines, 38, Byrom-st, Liverpool; and St. Peter's House, Clerkenwell-rd, London, E.C. (*Tolch London*)

Tolhurst & Son, Manufacturers of Insulating Materials, 1A, Bowling Green-ln, London, E.C.

Tolra & Co, Electrical and Mechanical Agents, 8, Adam-st, Adelphi, London, W.C. (*Tolra London*)

Tolrá y Fornés, Eduardo, Technical Translator, 70, Cornhill, London, E.C.

Tomlin, J., Engineer and Tool Maker, Queen's-rd, Barnsley, Yorks.

*Tomlinson, Herbert, Electrician, 36, Burghley-rd, Highgate-rd, London, N.W.

Tomlinson, Thomas, Electrical Engineer, Lynton, Durham-rd, Raynes Park, Surrey

Tompkins, H. K., Electrician, 52, Whiteley-rd, Gipsy Hill, London, S.E

Tonge, J. H., Electrical Engineer, National Electric Supply Company, 119, Fishergate, Preston

Tonks (Geo. T.) & Co, Limited, Electric Light Fittings Maker, 62, Rea-st, Birmingham

Tonks, Limited, Manufacturers of Electric Light Fittings, and Iron and Brass Founders, 201, Moseley-st, Birmingham; and 57, Holborn-viaduct, London, E.C. (*Brass Birmingham*)

Tooker, J. J., Electrical Engineer, 1, Keppel-ter, Stoke, Devonport

Tooley (Henry) & Co, Limited, Mechanical and Electrical Engineers, 63, Weaman-st, Birmingham

Topham (Charles) & Co, Wire Workers and Weavers, 11, Roscoe-st, Bunhill-row, London, E.C.

Topping, F. W., Superintendent Direct United States Cable Company, Ballinskelligs, co. Kerry, Ireland

Tosh (David) & Son, Lightning Conductor Manufacturers and Erectors, 77, Queen-st, Glasgow; and 3 and 11, Brougham-st, Greenock. (*D. Tosh Greenock, 256*)

Tough, J J., Electrician and Engineer, 13, Benthal-rd, Stoke Newington, London, N.

Towell, Charles, Electric Bell Fitter, 2, South-st, Bromley, Kent

Townley, Benjamin, Electrician and Maker of Burglar Alarms, Nelson-st, Greenwich, London, S.E.

Townsend (Hy A.) & Co, Electricians 367, St. James-rd, London, S.E.

TOWNSEND & McINTYRE, Electrical Engineers and Art Metal Workers (Office and Show-room), 15, Brook-st, W., and (Works) 189, Drummond-st, Euston-rd, N.W., London (*Fulgor London, 35157*)

Townshend & Co, Art Metal Workers and Manufacturers of Electric Light Fittings, Ernest-st, Birmingham; and 62, Holborn-viaduct, London, E.C.

Townson & Mercer, Electrical Apparatus Makers, 89 Bishopsgate-st Within and 11, Bishopsgate-avenue, London, E.C. (*Townson London*)

Toynbee Hall Electrical and Chemical Societies, 34, Commercial-st, London, E.

W. H. Preece, C.B., F.R.S. ... President
Dr. — Fison ..... Instructor in Electricity
A. P. Laurie, M.A., B.Sc. ... .. Instructor in Chemistry
A. E. Calvert, M.E. .. .. } Secretaries
K. Jameson, M.A. ..... }

Tracey, H. J., Superintendent Commercial Cable Company, Glasgow, and Scotch stations (*3349*)

Tracey, John Hart, Engineer, 18, Compton-st, Clerkenwell, London, E.C.

Trade Marks Journal (weekly), 38, Cursitor-st, Chancery-lane, London, W.C. (Ann. sub., 26s., post free; single copies, 6d.)

Traies & Son, Electrical Engineers and Contractors, 8, High-st, Notting Hill, London, W.

Traill, Wm. A., C.E., Electric Railway and Tramway Engineer, Giant's Causeway Electric Tramway Company, Portrush, co. Antrim, Ireland. (*Trailway Bushmills*)

Tralen, Chris. T., Electrician, 37, Landcroft-rd, East Dulwich, London, S.E.

Tramways Institute, Finsbury-circus-buildings, 18, Eldon-st, and 19, Finsbury-circus, London, E.C. (J. G. B. Elliot, Secretary) (*825*)

Transactions of the North of England Institute of Mining and Mechanical Engineers (periodically), published by the Institute Newcastle-upon-Tyne

Travers, G., Electrician, Gas Works, Cork

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Treglohan, Thomas P., Electrician, c/o Plymouth and District Students' Association, Plymouth

Trehane, F. W., Electrician, Llynderw, Llanishen, near Cardiff

Treherne, Hugh, Electrical Engineer, 5, Bedford-gdns, Kensington, London, W.

Trent Gas Engine Company Limited—*in liquidation.* (Robert Mellors, C.A., Nottingham, Liquidator)

Trentham, W. H., Electrical Engineer, 39, Victoria-st, London, S.W.: and at Bristol

Treuenfeld, R. von Fischer, Electrical Engineer, 12, Queen Anne's-gate, and The Glen, Endlesham-rd, Balham, London, S.W.

Trevenen & Lovett, Engineers North London Engine Works, 465A, Caledonian-rd, London, N.

Trevett, B., Electrical and Mechanical Engineer, 122, Mallinson-rd, Wandsworth Common, London, S.W.

Trezise, J. M. G., Electrician, 13, Clifford's Inn, London, E.C.

Trimming, P., Electrician, 31, Eastbourne-st, Sittingbourne, Kent

Trinity House, Tower Hill, London, E.C. (*For Officials, see p. 233*)

Tritton, J. Herbert, Chairman Indo-European Telegraph Company, Limited, 11, Old Broad-st, London, E.C.

Trollope (George) & Sons, Electric Light Engineers, 7, Hobart-pl, Eaton-sq (*3103*), Halkin-st, (*3179*), 15, Parliament-st West, and 77, Grosvenor-rd, London, S.W.

Trotter, A. P., Civil Engineer, 28, Victoria-st, S.W. (*3086*), and 1, 2 and 3, Salisbury-court, Fleet-st, E.C. (*2714*), London

Trotter, Howard B., Electrical Engineer, 176, Adelaide-rd, Hampstead, London, N.W.

Trott, N. W., Electrician, The Pines, Beer, near Axminster, Devonshire

*Trouton, Frederick Thomas, M.A., D.Sc., Electrician, Trinity College, Dublin

Truman, Edwin Thomas, M.I.E.E., 23, Old Burlington-st, London, W.

Tuam Electric Lighting Company, Limited, Tuam, co. Galway, Ireland

Tubb, Albert, Telegraph Engineer, Postal Telegraphs, Southampton

Tubular Frame Wagon Company, Limited, Mechanical Engineers, 18, Bishopsgate-st Within, London, E.C. (*4084*)

Tuck & Co, Limited, India Rubber Makers, 116, Cannon-st, London, E.C. Works: Albert Embankment, London, S.E.; 13, Aston's Quay, Dublin; and at Liverpool and Cardiff. (*Tucks London, Tucks Dublin*)

TUCKER, GEORGE, Printer and Publisher of *The Electrician*, &c., &c., 38, Albion-rd, Stoke Newington-green, N., and 1, 2, and 3, Salisbury-ct, Fleet-st, E.C., London. (*Electrician Newspaper London, 2714*)

Tucker (J. H.) & Co., Makers of Fittings and Accessories for Electric Lighting, 10, Ryland-st, Birmingham

Tucker Bros., Metal Workers and Brass Finishers, Esher-st, Kennington, London, S.E.

Tudsbury & Sons, Makers of Wimshurst Machines, Edwinstowe, Newark. (*Tudsbury Edwinstowe Newark*)

Tullis, D. & J., Makers of Wire-Braiding Machines, Royle Iron Works, Old Edinburgh-rd, Parkhead, Glasgow

Tullis (John) & Son, Driving Band Makers, St. Ann's Leather Works, John-st, Bridgeton, Glasgow; and 5, Blackfriars-st, Manchester; 5, Laurence Pountney Hill (Export only), and 22, St. Mary Axe (Consumers only), London, E.C.: and at Birmingham and Leeds. (*Tullis Glasgow, 2520; Cordovan Manchester*)

Tully, Wm., Consulting Engineer, 3, Crosby-sq, London, E.C.

Tumber, E. J., Electrical Engineer, Ford-Lloyd Manufacturing Company Limited, 2-8, Mount Pleasant, Clerkenwell, London, E.C.

Tunbridge, W. T., Telegraph Engineer, London and North-Western Railway, Stafford. (*Tunbridge Stafford*)

*Tunzelmann, G. W. de, B.Sc., Consulting Electrician, 65, Longridge-rd, and Electrical and General Engineering College, Penywern House, 2 and 4, Penywern-rd, Earl's Court, London, S.W. (*Tunzelmann London*) **See Advt., p. 461**

Turnbull, Charles, jun., Electrical Engineer, 3, St. Nicholas-bldgs, Newcastle-on-Tyne

Turnbull, John, jun., Consulting Engineer & Turbine Manufacturer, 18, Blythswood-sq, Glasgow (*Turbine Glasgow, 59*)

Turner, Archer, Resident Engineer, Central Electric Light Station, Larne, Ireland

Turner, A. W., Dealer in Electric Safety Lamps, Cobden-bldgs, Birmingham

TURNER BROS, Asbestos and Hair-Belting Manufacturers, Spotland, Rochdale; and 46, Fenchurch-st, London, E.C. (*Turners Rochdale, 3*)

Turner Bros, Manufacturers of Dynamo Plates, Forgings, &c., 134, Upper Thames-st, London, E.C.

Turner & Co., Engineers, Ironfounders, &c., 1, George-st, Lisson Grove, London, N.W. (*Tension London*)

Turner, Chas., Electrical Engineer, 2, Belmain-villas, Woking

Turner, G. G., Electrician, 3, St. Nicholas-bldgs, Newcastle-on-Tyne

Turner, Geo. C., Electrician, 12A, Upper Woburn-pl, London, W.C.

Turner (H.) & Son, Electric Light Contractors, 28, Villiers-st, Strand, London, W.C.

Turner, J. J., Axle Maker and Pivoter for Electrical Instruments, 4, Avenell-rd, Finsbury Park, London, N.

Turner, John W., Telegraph Engineer, Postal Telegraph Factory, Bovay-pl, Holloway, London, N.

Turner Patent Oil Filter Company, Makers of the Turner Patent Oil Filter, 109, Church-st, Preston, Lancs

Turner, W., Electrical Engineer, 16, Reservoir-rd, Brockley, Kent

Turney, A. T., Electrical Engineer, Berghill-rd, Sydenham, London, S.E.

Turvey & Gullette, Manufacturing Electrical Engineers, White Horse Electrical Works, 19a, Cow Cross-st, London, E.C.

Tuteur, Emil, Dealer in Electric Light Carbons, 72, Mark-lane, London, E.C.

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Tutte, H. E., Electrician, 10, West-st, Fareham, Hants.

Tweddell's System, Limited, Makers of Cranes, Lifts, &c., 14, Delahay-st, Westminster London, S.W. (*Tweddell Westminster London*)

*Tweeddale, Marquis of, Yestor, Gifford, Haddington, N.B. (*Tweeddale Gifford*)

Tyer (E.) & Co, Electrical Engineers and Contractors, Post Office-chmbrs, Newcastle-on Tyne

Tyer, Edward, F R.A.S., F.R.G.S., Electrician, Horneck, Fitzjohn's-avenue, Hampstead, London, N.W.

Tyler, E. G., Electrical Engineer, 19, Buckingham-st, Strand, London, W.C.

Tyler (Hayward) & Co, Electrical and General Engineers, 90 and 92, Whitecross-st, London, E.C. (*Tyleroz London, 192*)

Tyler, W. J., Secretary India Rubber, Gutta Percha and Telegraph Works Company, Limited, and Spanish National Submarine Telegraph Company, Limited, 106, Cannon-st, London, E.C.

Tylor (J.) & Sons, Limited, Hydraulic and General Engineers, 2, Newgate-st, E.C., and Belle Isle, King's Cross, N., London (*119*)

Typke & King, Acid and Chemical Manufacturers, 22, Laurence Pountney-lane, London, E.C. (*Valerianic London, 11402*)

— U —

Udal, Sons & Symonds, Metal Workers and Manufacturers of Electric Light Fittings, Birmingham

Ullathorne & Edmondson, Electrical Engineers and Contractors, 23, Charles-st, Bradford; 10, Basinghall-st, Leeds (*1086*); and 22 & 24, Imperial-arcade, Huddersfield

Ullett, J. W., M.I.E.E., Telephone Engineer, National Telephone Company, 65A, Station-st, Nottingham

Ullmann, W. C., Electrician, 26, Waterloo-rd, London, S.E.

Ungar (Julius) & Co, Electricians and Lamp Manufacturers, 327, Upper-st, London, N. (*756.2*)

United Alkali Company, Limited, (Head Office) Exchange-bldgs, Liverpool. (An amalgamation of 51 Chemical and Salt Works.) (*Ubique Liverpool, 1185*)

United Asbestos Company, Limited—*see* Asbestos Company (The United)

United Electric Light Company, Electric Light Engineers and Contractors, 5, Featherstone-bldgs, Holborn, London, W.C. (John Wright, General Manager)

United Electric Wire Company, Makers of Insulated Wire and Cables, 14A, Clerkenwell-green, London, E.C.

United Electric Tramways, Limited, c/o Messrs. Siemens Bros. & Co, Ltd, 12, Queen Anne's Gate, London, S.W.

See also page 298.

United Gutta Percha and Rubber Company, Limited, Gutta Percha and India Rubber Manufacturers, 180, West George-st, and (Works) Craig-park, Townmill-rd, Glasgow

United Hardware Company, Limited, Electrical Engineers, Ironmongers, &c., Grimsby

United Inventions Syndicate, Limited, Electrical Engineers, 39, Victoria-st, London, S.W.

United States Metallic Packing Company, Limited, Soho Works, Thornton-rd, Bradford. (*Metallic Bradford, 604*)

United Oils Co, Dynamo Oil Manufacturers, 9, London-st, E.C. and Bowles Wharf, Broad-st, Ratcliff, E., London, (*Voltzine London*)

United River Plate Telephone Company, Limited, 9, New Broad-st, London, E.C. (*Untel London, 1498*)

J. Irving Courtenay ... Chairman
F. W. Jones ... ... Managing Director
Robert Herring ... ... Secretary

See also page 298.

Universal Electric Lighting Co, Ltd, Electrical Engineers, 18, Eldon-st, London, E.C.

See also page 298.

Universal Arc Lamp Syndicate, Limited, Makers of the Universal Arc Lamp, 4, Arthur-st, New Oxford-st, London, W. (T. H. Robinson, Secretary) (*Moonlight London*)

See also page 298.

University College, Bristol ... ...
University College, Dundee .. ..
University College, Glasgow ... ...
University College, Liverpool ... ...
University College, London .. ..
University College, Nottingham ... ...
University College of North Wales, Bangor
University College of South Wales and Monmouthshire, Cardiff ... ...
University College of Wales, Aberystwith

For Lists of Professors see pages 264 to 273

Unwin, P. Ibotson (Engineer and Manager, Elliott's Metal Company, Limited), Lordswood-lodge, Harborne, Birmingham

*Unwin, W. C., F.R.S., M.I.C.E. (Professor of Engineering at the Central Institution City and Guilds of London), 7, Palace-gate-mansions, Kensington, London, W.

*UPWARD, A. RÉNÉ, Consulting Engineer and Electro-Chemical Specialist, 150, Holland-rd, Kensington, London, W.

Urquhart, David, A.I.E.E., Consulting Electrical Engineer (Urquhart & Small), 17, Victoria-st, London, S.W.

URQUHART & SMALL, Electrical Engineers, 17, Victoria-st, London, S.W. (*Eudiometer London*)

Usher (Thos. G.) & Co, Manufacturing Electricians, Norfolk-st, Sunderland; and Eldon-lane West, Newcastle-on-Tyne. (*1058*)

— V —

Vacher, H. P., Turbine Maker, &c., Vulcan Iron Works, Winchester (*Vacher Worthy Winchester*)

Vacuum Oil Company, Lubricating Oil Manufacturers, The Albany, Liverpool; and 47, Victoria-st, London, S.W. (C. C. Wakefield, General Manager) (*Vacuole London, 3274*)

Val d'Aosta Syndicate, Limited, Miners and Electrolytic Copper Manufacturers, Mansion House-bldgs, Queen Victoria-st, London, E.C.; and Val d'Aosta, Italy. (F. R. Reeves, Secretary)

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Valentine, W. A., Lancashire District Manager of the National Telephone Company, Limited, 38, Faulkner-st, Manchester. (*Telephone Manchester*)

Valon, William A., Civil Engineer, 8, Chapel-pl Ramsgate (*Valon Ramsgate*)

*Van Tromp, B. H., Director of the Brush Electrical Engineering Company, Limited, and City of Bath Electric Lighting and Engineering Company, Limited, 4, Hyde Parkter, London, W.

Van Wart, Leighton & Co, Aluminium Manufacturers, 110, Cannon-st, London, E.C.

Varley & Walker, Manufacturing Electricians, 36, Gillett-rd, Birmingham

Varley, A. F., Assistant Controller Stores Department, Post Office Telegraphs, Telegraph-st, London, E.C.

*Varley, F. H., Electrical Engineer, 82, Newington-green-rd, London, N.

*Varley, S. A., Electrical Engineer, 53 and 54, Chancery-lane, London, W.C.

Vasey (H. J.) & Co, Engineers and Dealers in Electrical Machinery, Mansion House-chmbrs, 10, Close, Newcastle-on-Tyne

Vaudrey, John C., Electrical Engineer, Grassdale, Westfield-road, Edgbaston, Birmingham

VAUGHAN & BROWN, Electric Light Fittings Makers, 15, 16 and 17, Kirby-st, Hatton-gdn, London, E.C. (*Vaughan Brown London*) **See Advt., p. 488**

Vaughan-Sherrin, J., Electrical Engineer, 55, Stockwell Park-rd, Brixton, London, S.W.

Vaughan & Sons, Engineers and Manufacturers of Electric Cranes, West Gorton, Manchester (*Vaunting Manchester*)

Vaughan-Stevens, A., Managing Director Okonite Company, Limited, 38, Finsbury-pavement, London, E.C.

Vaughton (Ernest E.) & Titley, Electrical Engineers, 26, Great Charles-st, Birmingham

Veal, E., Electrical Apparatus Manufacturer, Wellingborough

Veale & Co, Limited, Electric Light Engineers and Contractors, Menacuddle-st, St. Austell, Cornwall

See also page 298.

Vecqueray, Edward Guillaume, Electrical Engineer, Heathfield, Glenluce-rd, Blackheath, London, S.E.

Venezuela Telephone and Electrical Company, Limited, 37, Lombard-st, London, E.C.

Sir D. Fox ... ... Chairman
J. Simpson ... ... Secretary

See also page 298.

Venice and Murano Glass and Mosaic Company, Limited, Makers of Glass Globes, &c., 30, St. James'-st, London, S.W.

Venman, Hezekiah, Electrician, 20, Pimlico-rd, London, S.W.

Vennedt, C. F., Superintendent Great Northern Telegraph Company, 3, St. Helen's-pl, E.C.

Verey (A.) & Co, Dealers in Electrical Apparatus and Gutta Percha Merchants, Dover

VERITY (B.) & SONS, Electrical Engineers and Contractors, 31 and 32, King-st, Covent-gdn, W.C., and 137, Regent-st, W., London; Plume Works, Aston, Birmingham; 29, Princes-st, Manchester. (*Electroler London, 2648; Electricity Birmingham, 2565*)

VERITY, JOHN B., Electrical Engineer (B. Verity & Sons), 31 and 32, King-st, Covent-gdn, W.C.; and Moorcroft, Weybridge, Surrey.

Vesey, Arthur H., M.I.C.E., Consulting Civil and Electric Light Engineer, Bradon House, George-st, Croydon

Vickers (Percival) & Co, Limited, Manufacturers of Electric Light Shades, Retorts, &c., 64, Jersey-st, Manchester

Victoria University, Manchester (*For Colleges and Professors, see pages 264 to 273*)

Vidalon Paper Mills (ancienne Manufactures, Canson & Montgolfier), Telegraph Tape Paper Manufacturers, 165, Queen Victoria-st, London, E.C. (H. Luquet, Agent.) (*See also* CONTINENTAL DIVISION)

Vierordt & Co, Manufacturers of Electrical Apparatus, 28, Falcon-sq, London, E.C. (B. Hillmann, Agent)

Vigers Bros, Makers of Electric Wire Casings, 214, Pavilion-rd, Sloane-sq, London, S.W.

Vignoles, E. B., Electrician, 28, Lanhill-rd, Elgin-avenue, London, W.

Vigor & Co, Electric Light and Telephone Engineers, 15, King-st, Poplar, E., and 49, Southampton-row, W.C., London

Vile, William, Electrical Instrument Jeweller, 18A, Northampton-sq, London, E.C.

Viles, E. B., Consulting Electrical Engineer, Ravensworth, St. John's Wood Park, London, N.W.

VINTER, W., Instrument Engraver and Divider, 3, Dyers'-bldgs, Holborn, London, E.C.

Vivian (F.) & Co, Electrical and Mechanical Engineers, 103, Fulham-rd, South Kensington, London, S.W.

*Volk, Magnus, Electric Traction Engineer, Electric Railway, Brighton (*Volk Brighton*)

Von Buch, Carl, Electrical Engineer, 11, Queen Victoria-st, London, E.C. (*1928*)

Vorley, H. B., Electrician, 82, Highbury Newpark, London, N.

Vose, H. J., Superintending Engineer Postal Telegraphs for South Wales District, Cardiff

Voysey, A. Annesley, Electrician, St. Valery, Finchley-rd, West Hampstead, London, N.W.

Vyle, G. C., Electrical Engineer, 33, Southey-st, Nottingham

W

Wade (J. L.) & Co, Limited, Boiler Fluid, &c., Manufacturers, Victoria Works, Manor House Wharf, Nine Elms-lane, London, S.W. (*Calcareous London, 9073, 8536, 5137*)

Wade, Joseph Arthur, Electrician, 23, Huntley-rd, Fairfield, near Liverpool

WADE (R.), SONS & CO, Hull and West Hartlepool. General Timber Merchants, Importers of Telegraph Poles, Stay Blocks, Oak Arms, &c., Creosote Works, Hull. (*Wade Hull, P.O. 53, Nat. 80.*) **See Advt., p. 635**

Wadham, Arthur, Engineer and Exporter of Machinery, &c., 171, Queen Victoria-st, London, E.C. (*Wadham London*)

Wadsworth, Russell, Electric Bell Fitter, 27, Ebury-st, London, S.W.

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Wagner, C. T., Electric Bell Maker and Fitter, 206 and 207, Upper Thames-st, London, E.C.

Wailes (George) & Co, Iron and Brass Founders, 258, Euston-rd, London, N.W.

Wainwright, C., Engineer and Electrician, 1, Church-st, Castleford

WAKE & SANDERS, Mica Merchants, 3, Crosby-square, Bishopsgate-st Within, London, E.C. (*Awake London, 2388.*) **See Advts., p. 470, &c.**

Wakley, W. R. C., Electrical Engineer, 23, Princes-sq, Bayswater, London, W.

Walby, J., Superintending Engineer, Northern District Postal Telegraphs, Belfast

Walenn, W. H., F.I.C., F.C.S., M. Phys. Soc. L., Consulting Electrician, 9, Carleton-rd, Tufnell Park, London, N.

Walker, Batt, & Phillips, Engineers and Boiler Makers, Victoria Iron Works, Kingswood, nr Bristol

Walker, E., Electrical Engineer, Junior Army and Navy Stores, Limited, York House, Regent-st, London, S.W.

Walker, E. O., C.I.E., M.I.E.E., Telegraph Engineer and Agent, Imperial Institute, London, S.W.

Walker, F. J., General Manager and Secretary, St. James and Pall Mall Electric Light Company, Limited, Carnaby-st, Golden-sq, W., and Mason's-yd, Duke-st, St. James, S.W., London

Walker & Hardwick, Electrical, Mining and General Engineers, Suffolk House, Cannon-st, London, E.C. (Albion T. Snell, Consulting Electrical Engineer)

Walker (Henry) & Son, Limited, Electrical, Manufacturing and General Engineers, Gallowgate Ironworks; and 55, Westgate-rd, Newcastle-on-Tyne

Walker, Henry, Electrical Engineer, c/o Messrs. Crompton & Co, Limited, Mansion House-bldgs, Queen Victoria-st, London, E.C.

Walker, J. E. B., Electrician, 104, Colmore-row, Birmingham

Walker (J.) & Co, Manufacturers of Lubricating Oils, &c., Lion Works, Love-lane, Shadwell, London, E. (*Lioncelle London, 5437*)

Walker, M., Electrician, 102, Chetwynd-rd, London, N.W.

Walker (M.) & Co, Consulting Electrical Engineers, 20, Batavia-bldgs, Hackins Hey, Liverpool

Walker (Sydney F.) & Co., Electrical Engineers, &c., Cardiff Electrical Works, Severn-rd, and 33, Castle-street, Cardiff. (*Dynamo Cardiff*)

*Walker, Sydney F., Electrical Engineer, 195, Severn-rd, Cardiff

Walker, William, Maker of Induction Coils, 5, North East Park-st, Dennistoun, Glasgow

Wallace, R. W., Electric Expert, 21, De Veregdns, Kensington, W. (*8769*), and 2, Harcourt-buildings, Temple, E.C. (*2893*) London,

Waller, Major C. B., Director of the London Electric Supply Corporation, Limited, 3, Adelphi-ter, London, W.C.

WALLER, J. E.—*see* Kincaid, Waller & Manville

WALLET (DUNCAN) & CO, Export Provision Merchants and Shippers of Bonded Stores for Cable Ships, &c, 114, Fenchurch-st, and 5, Victoria-warehouses, Mansell-st, London, E.C. (*Knapbottle London*) **See Advt., p. 10**

Wallis Bros, Manufacturing Electricians, 156, High-st, Lincoln

Wallis, Edwin C., Electrical Engineer, Messrs. Cuttriss, Wallis and Co, Limited, Camp-rd Leeds (*Cuttriss Leeds, 268*)

Wallis, F., Electrical Engineer, Central Electric Light Station, Lynmouth, North Devon

Wallis-Jones, Reginald John, Electrical Engineer, Messrs. Kincaid, Waller & Manville, 29, Great George-st, London, S.W. (*Wallis-Jones c/o Kincaid London, 3011*)

Walmsley (Charles) & Co, Limited, Electrical and Mechanical Engineers, Elton, Bury, Lancs.

Walmsley (Thos.) & Sons, Iron Manufacturers and Merchants, Atlas Iron Works, Bolton, (*Walmsley Bolton, 30*)

*Walmsley, R. Mullineux, D.Sc., F.R.S.E., &c, Consulting Electrician and Professor of Electrical Engineering, Heriot-Watt College, Edinburgh

Walrond, T. C. T., A.M.I.C.E., A.I.E.E., Consulting Engineer, Albany-bldgs, 47, Victoria-st, London, S.W. (*Logistics London*)

Walpole, Spencer, Secretary to the General Post Office, St. Martin's-le-Grand, London, E.C.

Walsall Electrical Company, Limited, Electrical Apparatus Makers, 57, Bridge-st, and (Works) Butts Mills, Walsall, Staffs. (*Electrical Company Walsall, 6045*)

See also page 279

Walsh (H.) & Son, Electric Light Contractors, 50, Wade-lane, Leeds. (*645*)

Walsh, J. Walsh, Maker of Electric Light Fittings, 4, Holborn-circus, London, E.C.

Walter, L. H., Electrician, 56, Victoria-st, London, S.W.

Walter, L. G., Electrician, 49, Great Percy-st, London, W.C.

Walter, Henry E., Electrician, 56, Victoria-st, London, S.W. (*Saturation London*)

Walters (Philip) & Co, Telegraph and Electrical Engineers, 249 and 251, Kensal-rd, N.W., and Conlan-st, W., London

Waltham Electrical Engineering Company, Electrical and Mechanical Engineers, Chapel-pl Works, Great Chapel-st. Westminster, London, S.W. (*Switchboard London*)

Waltham, J. C., Electrical Engineer (Thompson, Ritchie & Co, Limited), 48, James-st, Buckingham Gate, London, S.W.

Walton, D., Dynamo and Magnetic Machine Maker, Hebden Bridge, Yorkshire

Walton (John) & Sons, Leather Driving Band Manufacturers, 36, Charlotte-lane, and Lanark-st, Glasgow. (*Waltonian Glasgow, 663*)

Wannell, Mrs. P., Teacher of Telegraphy, 41, Camden-rd, London, N.W.

Wanzer and Defries Patent Safety Lamp Manufacturing Company, Ld, 101, Farringdon-rd, London, E.C. (*Safety Lamp London*)

Warburton, H. N., Electrical Engineer, Astral Works, Blockley, Worcestershire

Warburton, J. S., Electrician, 49, New-rd, Grays, Essex

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Warburton (W.) & Co, Turbine Makers, Turbine Works, Halifax

Ward & Adams, Manufacturing Electricians, 191, Harold-rd, Upton Park, London, E.

Ward Bros. & Co, Electricians, 11, Binden-rd, Shepherd's Bush, London, W.

Ward Bros., Electrical Engineers, 22, Beer-lane, London, E.C.

Ward Electrical Car Company, Limited, 38, Gracechurch-st, E.C.

Ward, C. S., Electrical Engineer, Electrical Department, Midland Railway, Birmingham

Ward, Fred, Superintendent Commercial Cable Company, Richmond-rd, Weston-Super-Mare

Ward, Geo. Matthew, Electrical and Civil Engineer, 17, Barlow-st, Gorton, near Manchester

Ward (J. H.) & Co, Manufacturing Electricians, Gorton Brook Electric Works, Manchester

Ward, Norman, Telephone Engineer, National Telephone Company, Oxford-ct, Cannon-st, London, E.C.

Ward, Paul, Electrician and Experimental Chemist, Glow Lamp Froster and Tinter, 16, New Crown-ter, Fulham, London, S.W.

Ward, Radcliffe, Electrical Engineer, 38, Gracechurch-street, London, E.C.

Warde, Henry W., Electrical Engineer, 196, St. Vincent-st, Glasgow

Warden (Joseph) & Sons, Telegraph Wire Manufacturers, Broad-st, Birmingham ; and 110, Cannon-st, London, E.C.

Warden, Willoughby, Representative for Scotland and Belfast of Messrs. G. E. Belliss & Co, 60, Robertson-st, Glasgow

Waring, E. L., Electrician, South Tower, Crystal Palace, London, S.E.

Waring, Harold, Electric Light and Power Engineer, 16, Alexandra-rd, and Corporation Gas Works, Watmore-rd, Burton-on-Trent

Waring, R. S., Consulting Engineer and Inventor of the Waring Anti-Induction Cables, 16, St. Helen's-pl, London, E.C.

Waring (S. J.) & Sons, Limited, Electric Light Contractors, 181, Oxford-st, London, W. ; and at Liverpool and Manchester

Warner, R. D., Electrician, Brooklyn-rd, Shepherd's Bush, London, W.

Warner, Wm., A.M.I.C.E., Electrical Engineer, Hope Drive, The Park, Nottingham

Warner (John) & Sons, Limited, Mechanical, Hydraulic and Electrical Engineers, 27, Jewin-crescent, London, E.C.

Warne (W) & Co, India Rubber Manufacturers, 29, Gresham-st, London, E.C., and at Tottenham. (*Caoutchouc London*)

Warner (Robert) & Co, Turbine Makers, 27, Jewin-crescent, London, E.C. ; and Engineering Works, Walton-on-the-Naze, Essex (*Hydrological London*)

WAR OFFICE, Pall Mall, London, S.W. (*For Officials, see page 232*)

Warren, H. N., Chemist and Electrician, Everton Research Laboratory, 18, Albion-st, Everton, Liverpool

Wassell, G., Electrical Engineer, 25, Centre-st, Glasgow.

Warwick, Benjamin, Electrician, 134, Highbury-hill, London, N.

Waterfall & Barber, Electrical Engineers and Contractors, Sheffield

WATERHOUSE ELECTRICAL MANUFACTURING COMPANY, Limited, Makers of the Waterhouse Arc Lamp and the Waterhouse Electricity Meter, 67, Southwark Bridge-rd, London, S.E. (*Obliquely London, 11491*) **See Advt., p. 443.**

See also page 299.

Waterhouse Electro-Metric Syndicate, Limited, Electricians, 33, Old Broad-st, London, E.C. (J. J. Dale, Secretary)

See also page 299.

Waterhouse, J. C., Plumbago Crucible Manufacturer, Soho Works, Wakefield. (*Waterhouse Wakefield*)

Waterhouse, L. Maxwell, Consulting Electrical Engineer, 16, St. Michael's-pl, Brighton

Waterlow & Sons, Limited, Telegraph Paper Makers, Wholesale and Export Stationers, &c., &c., 25, 26, and 27, Great Winchester-st, 85 and 86, London-wall, E.C., and 49 and 50, Parliament-st, S.W., London ; and Dunstable and Birmingham (*Imprimerie London, 1378*)

Waterspout Engineering Company, Manufacturers of Steam Pumps, Sidney-st Works, Salford, Manchester (*Waterspout Manchester*)

Waterston (G.) & Sons, Sealing Wax Manufacturers, 8, St. Bride-st, London, E.C (*Waterstons London*)

Watford Engineering Company, Steam Engine and Gas Producer Manufacturers, Watford.

Watkin, Major H., R.A., A.I.E.E., Electrician, The Wilderness, Cautwell-rd, Woolwich, Kent.

Watkins, S., Chartered Patent Agent, Prince's-chmbrs, Prince's-square, Wolverhampton. (*7048*)

Watkinson, William H., M.I.M.E., M.I.E.E. Professor of Mechanical Engineering, Glasgow and West of Scotland Technical College, 38, Bath-st, Glasgow

Watkinson (W. J.) and Co., Electricians, 9, Union-st., Southport

Watney, Thos. S., Messrs. Shepherd & Watney, Electrical Engineer, 71, Albion-st, Leeds

Watson Bros, Opticians and Electrical Engineers, 31, Cockspur-st, London, S.W., and 41B, North John-st., Liverpool

Watson, Geisenheiner & Co, Electrical Engineers, 10, Glasshouse-st, London, W.

Watson, Alfred, A.I.E.E., Electrical Engineer, Messrs. Evered & Co, Limited, Barnet Works, Birmingham ; and 3, Grange-rd, Smallheath

Watson, J. R., Dealer in Electric Blasting Apparatus, 35, Queen Victoria-st, London, E.C.

Watson, G. L., Electrical Engineer, Messrs. Mavor & Coulson, 57, West Nile-st, Glasgow

Watson (Henry) & Sons, Engineers, Electric Bell Fitters, &c., High Bridge Works, Walker Gate, Newcastle-on-Tyne

Watson (J. W.) Clark & Co, Manufacturers of Electric Light Fittings, 23, Brooke-st, Holborn, London, E.C.

Watson, Laidlaw & Co, Friction Pulleys, Clutches, &c., Manufacturers, 98, Dundas st, Kingston, Glasgow (*Fugal Glasgow*)

Watson, T. J., Consulting Engineer, Union-chmbrs, Grainger-st, Newcastle-on-Tyne

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Watson (W) & Sons, Mathematical and Scientific Instrument Makers, 313, High Holborn, and 9-17, Fullwood's-rents, Holborn, London, W.C.

Watteville, A. de, M.A., M.D., B.Sc. late Electrotherapeutist to University College and St. Mary's Hospitals, 30, Welbeck-st, Cavendish-sq, London, W.

Watt (J.) & Co., Engineers and Boiler Makers, 90, Leadenhall-st, E.C., and Thames-pl, Limehouse, E., London; and Soho Mint and Foundry, Birmingham

Waygood (R.) & Co, Makers of Electric Cranes and Lifts, Falmouth-rd, Great Dover-st, London, S.E. (*Waygood London, 4760*)

Waynforth, Harry M., A.M.I.C.E., Consulting Engineer and Demonstrator in Engineering, Mason's College, Birmingham

Weatherall, T. E., Telegraph Construction and Maintenance Co, Limited, Enderby's Wharf, Greenwich, London, S.E.

Weaver, R., C.E., F.C.S., Consulting Sanitary and Ventilating Engineer, 87, Oxford-st, London, N.

Webb, E. March, Electrician, India Rubber, Gutta Percha, and Telegraph Works Company, 106, Cannon-st, London, E.C.

*Webb, F. H., 2, Victoria-mansions, Victoria-st, London, S.W. (Secretary of the Institution of Electrical Engineers, and Editor of the *Journal* of the Institution). (*3153*)

*Webb, Frederick Charles, c/o Institution of Civil Engineers, 25, Great George-st, London, S.W.

Webb (F.) & Son, Electric Light and Telephone Engineers and Electric Bell Fitters, 65, High-st, Leicester (*398*)

Webb & Son, Leather Driving Band Makers, Combs Tannery, Stowmarket. (*Webb Combs*)

Webb, W. R., Electrical Engineer, Bell and Telephone Contractor, Beaumont Electric Works, Leister-rd, East Finchley, and 12, Shaftesbury-rd, Hornsey Rise, London, N.

*Webber, Major-General C. Edmund, C.B., late R.E., M.I.C.E., M.I.E.E., Consulting Engineer, 27, Chancery-lane, London, W.C. (*Lightsome London*)

Webber, T. B., Electrical Engineer, 8, Kirkby-pl, North Parade, Plymouth

Webster, R. G., Chronometer Maker to Royal Navy, Non-Magnetisable Watch Maker, 5, Queen Victoria-street, London, E.C.

Webster, W., F.C.S., Electrical Engineer and Contractor, 22, Great George-st, Westminster, S.W., and 50, Lee-park, Lee, S.E., London (*3914*)

Wedekind, H., Engineer and Machinery Agent, 158, Fenchurch-st, London, E.C. (*Wittekind London*)

Weeks (W.) & Son, Limited, Mechanical and Electrical Engineers, Perseverance Iron Works, Maidstone, Kent

Weeks (J.) & Co, Boiler Makers, King's-rd, Chelsea, London, S.W.

Weems, J. & W.—*in liquidation.* (Mr. Gourlay, C.A., 24, George-sq, Glasgow, Liquidator)

Weighton, R. L., Professor of Electrical Engineering, Durham College of Science, Newcastle-upon-Tyne

WEILLER (LAZARE) & CO, Wire Makers, Paris and Angoulême, France. (Representative in Great Britain, Fernand Espir, *q.v.*) **See Advts.**

Weir, J., Superintendent Commercial Cable Company, Leith

Weise, B., Electrical Engineer, 160, Odessa-rd, Forest Gate, London, E.

Weiss & Biheller, Dealers in Glass Globes and Shades, China Insulators, &c., 71, Chiswell-st, London, E.C. (*Biheller London*)

Weldless Steel Tube Company, Manufacturers of Tubes, 303, Icknield Port-rd, Birmingham. (*Weldless Birmingham*)

Weller, Geo., Electric Bell Fitter, &c., 60, Newington-causeway, London, S.E.

Welfare, E J., Electrician, 39, Acre-lane, Brixton, London, S.W.

Wellington & Co, Manufacturers of the Ingersoll Electric Rock Drill, 100c, Queen Victoria-st, London, E.C.

Wells Bros, Makers of the Premier Gas Engine, Sandiacre, near Nottingham; and 73, Queen-Victoria-st., London, E.C.

Wells, Charles A., Mechanical and Electrical Engineer, Aetna Iron Works, Lewes. (*Wells Aetna Lewes*)

Wells, Douglas Lewis, M.I.E.E., M.Am.I.E.E., Hurstfield, The Avenue, Gipsy-hill, London, S.E.

Wells, Gallimore & Taylor, Limited, Manufacturers of Electric Bells, &c., Adams-st. Birmingham. (*Fides Birmingham, 2561*)

Wells, G. F., Electrical Engineer, 74, Prospect-st, Hull.

Wells, Robert, B.Sc., Consulting Engineer, Elswick Mechanics' Institute and Technical School, Newcastle-upon-Tyne

Wells, Sidney H., Wh.Sc., A.M.I.C.E., Principal of the Battersea Polytechnic Institute, Battersea, London, S.W.

Wells, T. H., Secretary of the Anglo-American Telegraph Company, 26, Old Broad-st, London, E.C.

Wells (W.) & Co, Electrical Engineers, "Toovies," Worth, Crawley, Sussex

Wellsted, W. H., C.E., M.I.E.E., Consulting Engineer, 1, Manor-st, Hull, Yorks.

Welsh, F. E., Electrical Engineer, Broome House, near Fence Houses, co. Durham

Welsh (John E.) & Co, Electrical Engineers and Model Makers, Hyde-park, Glasgow

Wenham Company, Limited—*in liquidation.* (E. Cooper, 14, George-st, Mansion House, E.C., Liquidator)

Wenham & Waters, Limited, Electric Light Engineers, 47, Oxford-st, London, W.

Wentworth & Co, Electrical Engineers, 102, Newgate-st, London, E.C. (*69*)

Wertheimer, J., B.A., B.Sc., F.I.C., F.C.S., Consulting Electrician, Head Master The Merchant Venturers' School, Bristol. (*407*)

WEST AFRICAN TELEGRAPH COMPANY, Limited, Winchester House, Old Broad-st, London, E.C. (*Gorilla London*) **See Advt., p. cxxvi.**

Sir John Pender, G.C.M.G., M.P.	Chairman
J. Denison Pender	Man. Direc.
John Cambrook	Secretary

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WEST COAST OF AMERICA TELEGRAPH COMPANY, Limited, 120, Cannon-st, London, E.C.
J. Denison Pender ... ... Chairman
Fred. L. Robinson ... ... Secretary
See also page 299

West (H. J.) & Co, General Engineers, 116 and 118, Southwark-bridge-rd, London, S.E. (*Copperworm London*)

WEST INDIA & PANAMA TELEGRAPH COMPANY, Limited, Dashwood House, 9, New Broad-st, London, E.C.
C. W. Earle ... ... Chairman
R. T. Brown ... ... Secretary
See also page 299

West, J., Electrical Engineer, 415 and 417, Brixton-rd, London, S.E.

West, Stephen, Consulting Engineer, 240, Borough, London, S.E.

Westall, George, Electrical and Mechanical Valuer, St. Stephen's-chambers, Telegraph-st, London, E.C.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY, Limited, 19, Great Winchester-street, London, E.C. (*Interval London, 1381*) (With which is incorporated the Montevidean and Brazilian Telegraph Company, Limited)
W. S. Andrews ... ... Chairman
Major A. Wood ... ... Managing Director
R. M. Cunningham ... Secretary
See also page 299

Western Counties and South Wales Telephone Company, Limited—*business taken over by the* National Telephone Company, Limited (*q. v.*)

Western Counties Electric Light and Power Syndicate, Limited, Electrical and Mechanical Engineers, Keynsham, Somerset. (S. F. Andrews, Secretary)
See also page 299.

Western Electric Company, Manufacturers of Telephones, Magneto Bells, Switchboards, and all Telephonic Apparatus, Patterson Cables, &c., 79, Coleman-st, London, E.C. (*Relay London, 418*) (*See also* AMERICAN DIVISION)

Western House-to-House Electricity Company, Limited, 13, John-st, Bristol
See also page 299.

WESTERN UNION TELEGRAPH COMPANY (Lessees of the American Telegraph and Cable Company), 252, Gresham House, Old Broad-st, 21, Royal Exchange, and 40, Mark-lane, London, E.C. (*Western Union London, 11041.*) (G. von Chauvin, Representative in England.) (*See also* AMERICAN DIVISION)
See Advt., p. cxxx., *and also page 299*

WESTINGHOUSE ELECTRIC COMPANY, Limited, Electrical Engineers, Manufacturers of and Contractors for Central Stations, Apparatus for Lighting, Power, and Traction (Sole Proprietors and Manufacturers of the Shallenberger Meter), Victoria-mansions, 32, Victoria-st, London, S.W. (*Mobilized London, 3176*) **See Advt., p. 487.** (*See also* AMERICAN DIVISION)
George Westinghouse, jun. ... Chairman
Arthur E. Scanes ... ... Secretary
See also page 299.

Westminster Electric Supply Corporation, Ltd. Eccleston-pl, Belgravia, London, S.W. Central Stations: Millbank-st, Westminster, and Eccleston-pl, Belgravia, S.W., and Davies-st, Mayfair, W. (*Visual London, 3271*)
Lord Suffield, K.C.B. Chairman
Capt. E. I. Bax ... ... General Manager
Prof. Alex. B. W. Kennedy, F.R.S., M.I.C.E. } Engineer-in-Chief
Frank Iago, F.I.S.... ... Secretary
See also page 300

Weston, A., Manufacturing Electrician, 177, Harrow-rd, London, W.

Weston & Co, Engineers and Steam Launch Builders, Dover

Weston, G. S., Electrical and Scientific Instrument Maker, 29, Tomlin's-grove, Bow, London, E.

Weston, Robert, Electrician, 100, Mortimer-rd, Kingsland, London, N.

Westwood, Chas., Dealer in Platinum, &c., 53, Great Hampton-st, Birmingham. (*Aurum Birmingham, 4094*)

Westwood (A.) & Son, Manufacturing Electricians, 21, Prince's-st, Perth

Wetton & Co, Electricians, 98, High-st, Cheltenham

Wetton, C. E., 11, Queen Victoria-st, London, E.C. (Representative of the Telegraph Manufacturing Company, Limited, Helsby, nr Warrington.) (*Concentric London, 1935*)

Weybridge Electric Supply Company, Limited, Thames-st, Weybridge (H. C. Buchanan, Secretary and Superintendent.) (*Whardown Weybridge*)
See also page 300.

Weygang, L. G., Electrician, 3, Hermitage-villa, Child's Hill, London

Weyman & Hitchcock, Limited, Engineers, Makers of the Trusty Petroleum and Gas Engines, Guildford (*Weyman Guildford*)

Weymersch Electric Battery Syndicate, Limited, c/o Messrs Mortimer Jones, Henry & Co., 12, Nicholas-lane, E.C., London. (C. F. Jones, Secretary)
See also page 300.

Weymersch, Henry, Electrician, 163, East Dulwich-grove, East Dulwich, London, S.E.

Weymouth, Geo. A. P., Electrician, 62, Delafield-rd, Charlton, Kent

Weymouth, F. M., Electrician, Author of "Drum Armature Winding and Commutators," 3, Goldsworth-villas, Heathfield-rd, Wandsworth, S.W.

Whalley, Alfred, Electrical and Mechanical Engineer, Ashville, Helsby, near Warrington

*Wharton, C. J., Electrical Engineer (Messrs. Laing, Wharton and Down), New Bond-st, London, W. (*Whardown London, 360.*)

WHEATLEY KIRK, PRICE & GOULTY, Electrical and Mechanical Auctioneers, Valuers and Arbitrators, 49, Queen Victoria-st, E.C.; and Albert-sq, Manchester. (*Indices London, 15077*; *Indicator Manchester*)

Wheeler, E. H., Electrician, Walton-rd, East Molesey, Surrey

Whessoe Foundry Company, Ltd., Mechanical, Electrical and Consulting Engineers, Iron Founders, Tool Makers, &c., Whessoe, Darlington; and 28, Queen-st, London, E.C.

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Whetham, W. C. D., M.A., Electrician and Assistant Demonstrator in Physics, Cavendish Laboratory, Trinity Coll., Cambridge

Whincop, H. C., Lightning Conductor Erector, 255, Bearwood-rd, Smethwick

Whitaker, James, Electrician, 191, Earl's Court-rd, London, S.W. (*8688*)

Whitaker, John, Electrician, 7, Clifton-rd, Eccles

Whitaker & Pollitt, Electricians, Blackfriars, Manchester

Whitcher, J., Electrician, 16, Brighton-rd, Stoke Newington, London, N

White & Henshall, Electrical Engineers, 6, Palatine-bldgs, Victoria-st, Manchester

White, Hyler, Consulting Electrician, 54, Foley-st, London, W.

White, James, Electrical and Scientific Instrument Maker, 16, 18, and 20, Cambridge-st, Glasgow. (*Meter Glasgow, 172.*)

White & Sons, Electric Light Fittings Makers, 207, Oxford-st, and (Works) Marlboro'-mews, London, W.

White, Thomas, Electrical Engineer, Messrs. Frank Suter & Co, 66, Berners-st, London, W.

White, T. M., Electrician, 9 and 11, Mill-st, Hanover-sq, London, W.

White & Woodington, Patent Agents, 27, Southampton-bldgs, London, E.C.

White, W., Electrician, 17, York-st, Nottingham

Whitecross Company, Ltd., Wire Manufacturers, Warrington; and 7, Jeffreys-sq, St. Mary-Axe, London, E.C. (*Telegraph Warrington*)

Whitehead (R. R.) & Bros, Limited, Felt Manufacturers, 10, Endell-st, London, W.C. (*Wandfelt London*)

Whitehouse & Co, Limited, Iron Telegraph Pole Manufacturers, Globe Tube Works, Globe-st, Wednesbury. (*Tubes Wednesbury; Tubes London, 6504*)

Whitehouse (Wm.) & Co, Manufacturers of Electric Light Fittings, Brueton-st, Birmingham. (*Empire Birmingham*)

Whitehouse, W. H., A.I.E.E., Electrician, Lecturer in Telegraphy, The Municipal Technical School, Birmingham

Whitelaw (A.) & Sons, Electrical and General Engineers, Grange Engineering Works, 16, Sciennes, Edinburgh

Whitelaw, Norman, Electrical and Mechanical Engineer and Inspector, 16, India-st, Glasgow

Whiteley (John) & Sons, Limited, Mechanical and Electrical Engineers, Brunswick Mills, Halifax

Whiteley, Wm., Electric Light Engineer and Contractor, Westbourne-grove (*7033*), and 149, Queen's-rd (*7135*), Bayswater, London, W. (*Whiteley London*)

Whitelow, E. T., Patent Agent, 70, Deansgate, Manchester. (*Allmann Manchester, 1824*)

Whitham (J. H.) & Co, Electrical Engineers and Contractors, 1, Arcade-chmbrs, St. Mary's-gate, and Bennett-st, Ardwick, Manchester. (*Crumpsall Lane Manchester*)

Whitley Partners, Limited, Telegraph Contractors, Railway Works, Hunslet-rd, Leeds. (*Torpedo Leeds*)

Whitney, E., Electrical Apparatus Maker, 117, City-rd, London, N. (*620*)

Whittaker & Co, Technical Publishers, 2, White Hart-st, Paternoster-sq, London, E.C.

Whittaker (W. L.) & Co, Electrical Engineers and Contractors, 85, Queen Victoria-st, London, E.C.

Whittle & Co, Electric Light Engineers and Contractors, Roper-st, Whitehaven

Whitwell, Arthur, M.A., Electrician, 251, Hartfield-rd, Wimbledon

Whitworth, H., Electrician, 11, St. Clement's-rd, Chorlton-cum-Hardy, Manchester

Whitworth (Sir Joseph) & Co, Limited, Engineers, &c., Whitworth-st, Openshaw, Manchester; and 32, Victoria-st, Westminster, London, S.W. (*Whitworth Openshaw*)

Whyte, Thomson & Co, Scientific Instrument Makers, 142 and 144, Broomielaw, Glasgow

Wickenden, A. H., Electrical Engineer, 39, Farquhar-rd, Upper Norwood, London, S.E.

Widnes Foundry Company, Manufacturers of Chemical Plant, Widnes, Lancs. (*Foundry Widnes*)

Wiener, L. (Wurtemberg Electro-Plate Company, Limited, Manufacturers of Galvano Bronzes), 91, Fore-st, London, E.C.

Wigan, Gordon, M.A., Electrician, Savile Club, 107, Piccadilly, London, W.

Wiggin (Henry) & Co, Limited, Electrical and Mechanical Engineers, Birmingham

Wiggins (F.) & Sons, Mica Importers and Manufacturers, 10, Tower-hill, and 102, Minories, London, E.C. (*Wiggins Minories London, 2248*)

Wightman, Richard, Electrician, 50, Woodlandter, Charlton, Kent

Wiklund, Carl, Consulting Electrical Engineer, 3, Great Winchester-st, London, E.C.

Wilberforce, L. R., Electrician, Cavendish Laboratory, Trinity College, Cambridge

Wilcox, George, Manufacturing Electrician, 116, Shakspear-rd, Stoke Newington, London, N.

Wild, A. M., Maker of Engineers' Tools, 13, High-st, Sheffield. (*A. M. Wild Sheffield, 352*)

WILD, DAGGER & CO, Electrical, Mechanical and Sanitary Engineers, 6B, The Temple, Dale-st, Liverpool

Wild, E., Consulting Engineer, 13, Huntley-rd, Elm Park, Fairfield, Liverpool

Wild (John) & Co, Limited, Mechanical and Electrical Engineers, Falcon-st, Oldham, Lancs.; and 11, Queen Victoria-st, London, E.C. (*Falcon Oldham*)

Wilder, F. L., Electrical Engineer, Sulham, Pangbourne, near Reading

Wilding, W. H., Electrician, 25, Mildmay-rd, Chelmsford

WILHELM & CO, Agents for the "Hard" Incandescence Lamp Company (of Zurich, Switzerland), 132, Wool Exchange, Coleman-st, London, E.C. **See Advt., p. 574**

Wilkin & Co, Electrical Engineers, 1, Florence-st, New Cross, London, S.E.

Wilkins & Co, Manufacturers of Lightning Conductors, 39, High-st, Wapping, E. (*Wilkins Wapping London*)

*Wilkins, J. W., Telegraph Engineer, 15, Lilford-rd, Coldharbour-lane, Camberwell, London, S.E.

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Wilkinson, Chas. H., Electrical Engineer, 11, Poultry, London, E.C.

Wilkinson, F. A., Electrician, 26, Davisville-rd, Shepherd's Bush, London, W.

Wilkinson (G.) & Son, Machine Tool Makers, Keighley

Wilkinson, Geo., Consulting Engineer and Electrician, Staveley-villa, St. Luke's, Southport

Wilkinson, H. D., M.I.E.E., Electrical Engineer, 79, Mildmay-rd, Stoke Newington, London, N.

Wilkinson, Heywood & Clarke, Manufacturers of Paints, Oils, &c., 7, Caledonian-rd, London, N.

Wilkinson, H. W., A.M.I.C.E., A.I.E.E., Manager and Engineer Eastbourne Electric Light Company, Junction-rd, Eastbourne

Wilkinson (Wm.) & Co, Electrical Engineers and Electrical Instrument Makers, 22, Cross Hills, Halifax, Yorks.

WILLANS & ROBINSON, Limited, General Engineers and Makers of the well-known Willans Engine, Ferry Works, Thames Ditton, Surrey, and 3, York-st, Lambeth, London, S.E. (*Willans Thames-Ditton*) **See Advt., p. 555**

See also page 300.

Willats (James) & Co, Electrical Engineers, 19, Grays Inn-rd, London, W.C.

WILLCOX (W. H.) & CO, Manufacturers of Engineers' Stores for the Electric Light, &c., Oil Refiners, &c., 34 and 36, Southwark-st, and Castle-st, London, S.E. (*Willcox Southwark-street London, 4740.*) **See Advt. inside front cover, page 1**

Willesden Waterproof Paper and Canvas Works Manufacturers of Paper for Insulating Purposes, Willesden Junction, N.W., and 51, Bow-lane, E.C., London; and 43, South John-st, Liverpool. (*Impermeable London*)

Williams, Allan, Electrician, 21, Shaa-rd, East Acton, London, W.

Williams, A. M., Electrician, 4, St. John's-ter, Weymouth

Williams & Bach; Makers of Electric Light-Shades, 92, New Bond-st; and 3, Woodstock-st, Oxford-st, London, W. (*Moluccas London*)

Williams Bros. & Co, Brass and Copper Tube Makers, Pershore-st, Birmingham. (*Tubes Birmingham, 425*)

Williams, C. T., Electrician, Electric Light Department, London & South-Western Railway Co., Waterloo Station, London, S.W.

Williams, Foster & Co, and Pascoe, Grenfell & Sons, Limited, Copper Smelters and Manufacturers of Copper, Morfa, and Middle Bank Copper Works, and Upper Bank Spelter Works, Swansea; Leadenhall-bldgs, and 27, Upper Thames-st, London, E.C. (*Willfost Londore, Turnover London, 11229*)

Williams, F., Engineer and Electrician, 48, Northampton-st, Clerkenwell, London, E.C.

Williams (John) & Co, Telegraph Wire Manufacturers, Excelsior Iron and Steel Works, Wishaw, N.B.

Williams, Lieut. B., R.E., A.I.E.E., Electrician, 7, Bedford-circus, Exeter

WILLIAMS, MORGAN I., M.A., A.M.I.C.E., 39, Victoria-st, London, S.W. (*Consonance London, 3039*)

Williams & Norgate, Importers of Foreign Scientific Books, 14, Henrietta-st, Covent Garden, London, W.C.; and 20, South Frederick-st, Edinburgh

Williams, Owen & David, Manufacturers of Electric Light Fittings, 402 and 404, Scotland-rd, and 12, 14, and 16, Taylor-st, Liverpool

Williams, Philip Henry, Electrician, Egham, Surrey

Williams (Samuel D.) & Co, Electrical Engineers, Newport, Mon. (*Samuel Williams Newport, 114*)

Williams, T. P., Manager Commercial Cable Company, 8, Forster-sq, Bradford. (*773*)

Williams (T. C.) & Sons, Electrical Engineers, Iron and Brass Founders. London-st, Reading. (*Williams Reading, 79*)

Williams, Capt. W., Electrician, 94, Tyrwhitt-rd, Brockley, London, S.E.

Williams, W., Electrician, 33, Green-park, Bath

Williams, W. H., Electrical Engineer, Messrs. Lewis & Co, Market-st, Manchester

Williamson, A. D., Electrician, c/o Messrs. Siemens Bros. & Co, Limited, Woolwich, Kent

Williamson Electrical Engineering Company, Limited—*in liquidation*. (J. E. Sharples, Liquidator)

Williamson, J. C., Manufacturing Electrician, 42, Rhodeswell-rd, Stepney, London, E.

Williamson, John, Electrician, 26, Alwyne-rd, Canonbury, London, N.

Willing & Sons, Mica Merchants, Bridge Works, Calvert-rd, Battersea, London, S.W.

Wills (C.) & Sons, Electric Bell Fitters, Seamoor-rd, West Bournemouth

Willson, H. C., Electrician, Elford House, Holyhead-rd, Coventry

Willway (J. S.) & Sons, Manufacturers of Electric Light Fittings, St. Augustine's-parade, Bristol. (*718*)

Willmot, J. W., Superintendent Postal Telegraph Factory, Bovay-pl, Holloway, London, N.

Wilmot, Thos. J., Superintendent Commercial Cable Company, Waterville, co. Kerry, Ireland

Wilmshurst, T. P., Borough Electrical Engineer, Town Hall, Halifax

Wilson, Alexander C., Electrician, 49, Springfield-pl, Leeds

Wilson (Alex.) & Co, Limited, Electrical and Mechanical Engineers, Vauxhall Iron Works, Wandsworth-rd, S.W., and 45, Leadenhall-st, E.C., London. (*Wellhole London*)

Wilson, Archibald, Electrical Engineer, 18, Warriston-cres, Edinburgh

Wilson, Ernest, M.I.E.E., Consulting Electrician and Demonstrator in Electrical Engineering, King's College, Strand, London, W.C.

Wilson, F., Electrician, 57, Lansdowne-pl, Brighton

Wilson (George) & Co., Electrical Engineers, Cambrian Electrical Works, Aberdare. (*Wilson Electrician Aberdare*)

Wilson, James, Consulting Engineer and Machinery Merchant, 264, Dobbie's Loan, Glasgow

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Wilson (J. G.) & Co., Consulting Engineers and Patent Agents, 55, Market-st, Manchester

Wilson (John H.) & Co, Limited, Engineers and Crane Makers, Bankhall Engine Works, Sandhills, Liverpool; and 6, Delahay-st, London, S.W. (*Engineers Liverpool*)

Wilson, J. R., Electric Light Engineer, 20, Oxford-st, Chorlton-on-Medlock, Manchester

Wilson (John) & Son, Makers of Machine Tools, Lead Cable-Covering Machines, &c, Vulcan Works, Johnstone; and 3, Oxford-st, Glasgow. (Alex. Wylie, Manager)

Wilson & M'Lellan, Electric Bell Makers, 104, Renfrew-st, Glasgow

Wilson & Clirehugh, Consulting Electrical Engineers, 68, Victoria-st, London, S.W.; and Temple Chambers, Brazenose-st, Manchester

Wilson & Son, Electric Bell Fitters, &c., 7, 8 and 9, King William-st, Strand, W.C., and 7, Rose-st, Soho, W., London

Wilson, W., M.A., Lecturer in Physics and Electrotechnology, Merchant Venturers' School, Bristol

Wilson, Wm. Alex., Electrical Engineer, c/o Messrs. Walker & Colbeck, 9, Parliament-st, Hull

Wilson (William) & Co, Electrical Engineers, Water-st Works, Middleton, Manchester; also at 50, King-st, Manchester. (*208*)

Wilson, W. H. M., Electrical Engineer, 51, Cromford-rd, West Hill, Wandsworth, London, S.W.

Wilson, W. R., B.Sc., Consulting Electrical Engineer, 75, Waterloo-st, Glasgow

Wimshurst, E. J., Electrician, 20, South-st, Huddersfield, Yorks.

Wimshurst, Hollick & Co, Electric Crane Makers, 602, Commercial-rd East, London, E.

*Wimshurst, James, Consulting Electrician, 4, The Grove, Clapham Common, London, S.W.

Winckel, F. G., Importer of Art Metal Works, 1, Fore-st-avenue, London, E.C. (*Fastigium London*)

Windsor and Eton Electric Light Company, Limited—*in liquidation*. (W. Sevenoaks, Acre House, Windsor, Liquidator)

Winfields, Limited, Manufacturers of Electric Light Fittings, Cambridge-st, Birmingham; and 49, Farringdon-st, London, E.C. (Walter Blenkarn, Representative for the Electrical Department.) (*Winfield Birmingham, 499; Winfield London, 2628*)

Winn (Charles) & Co, Electric Light Fittings Makers, St. Thomas Works, Granville-st, Birmingham; and 41, Holborn-viaduct, London, E.C. (*Winn Birmingham*)

Winn, W., Electrical Engineer and Contractor, 106, Union-st, Borough, London, S.E.

*Winslow, I. Everson, Electrical Engineer, Manager of the Roundhay Electric Tramway 1, Roseville-rd, Roundhay, Leeds

Winstanley-Wallis, T., Electrical Engineer, Messrs. J. H. Holmes & Co, 17, Coleman-st, London, E.C.

Winter, C. E., Electrical Engineer, Equitable Life Assurance Society of the United States, 81, Cheapside, London, E.C. (*Winter Incursim London*)

WINTER, F., Ebonite and Vulcanite Manufacturer, 138, London-wall, London, E.C. **See Advts., pp. 471, 575 and 642**

Winter, W. H., M.I.E.E., Electrical Engineer, 36, Margravine-gardens, Hammersmith, London, W.

Winton (C.) & Co, Electrical Engineers and Contractors, 35, Goodge-st, London, W.C.

Wise, Wm. Lloyd, Consulting Engineer and Patent Agent, 46, Lincoln's Inn-fields, London, W.C. (*Lloyd Wise London, 2766*)

WITTY & WYATT, Limited, Asbestos Manufacturers and Engineers' Furnishers, 88, Leadenhall-st, London, E.C. (*Witwy London, 4104*)

Woakes, Dr. Arnold B., Electrician, 78, Harley-st, London, W.

Wohle, S., Electrician, 27, Burton-cres, London, W.C.

Woking Electric Supply Company, Limited, School Board-rd, Woking.

See also page 300

Wolff (Rudolf) & Co, Metal Merchants, 12 Fenchurch-st, London, E.C. (*Occasion London*)

Wollaston, H. U., General and Electrical Engineer, c/o Messrs. W. Pope & Son, Limited, Slough, and Broad-st House, London, E.C.

Wolverhampton Electric Light and Power Company, Ltd, 80, Lichfield-st, Wolverhampton

See also page 300

Wood, A. H., Electric Light Contractor, 39, Victoria-st, London, S.W.

Wood Carving Company, Makers of Casings and Cleats, Commercial-st, Birmingham; and 90, Queen-st, London, E.C.

Wood (F.) & Co, Electric Light Engineers and Contractors, 53, Gt. Portland-st, London, W.

Wood, Henry George, A.I.E.E., South-Eastern Railway Telegraph Department, London Bridge, London, S.E.

Wood, H. Raymond, Electrical Engineer, Messrs. B. Verity & Sons, 31, King-st, Covent Garden, London, W.C. (*2648*)

Wood & Horspool, Electricians and Ironmongers, Newport, Isle of Wight

Wood, J. & E., Engineers, Millwrights, &c, Spard, Bolton, Lancs. (*Woods Bolton, 45*)

Wood, Sir Henry Trueman, M.A., Society of Arts, John-st, Adelphi, London, W.C.

Wood, Reginald, Electrical Engineer, 57, Gower-st, London, W.C.

Wood, S. P., Contractor for Electrical Work of all Kinds, 10, Paragon-st, Hull

Wood (W.) & Co, Makers of China and Porcelain Switches, Fittings, &c., Albert-st Works, Burslem.

Woodall & Son, Glass Manufacturers for Electrical Purposes, St. George's Glass Works Birmingham; and 12, St. Andrews-st, Holborn-circus, London, E.C.

Woodham, Smith & Co, Electrical Engineers and Contractors, Ducie Chambers, 57, Market-st, Manchester

Woodhead, Thos., Commission Agent and Dealer in Electrical Supplies, Prudential-bldgs, Park-row, Leeds. (*Woodhead Prudential-bldgs Leeds*)

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Woods (T. G.) & Sons, Jewellers of Electrical, Telegraphic, and Scientific Instruments, 54, Spencer-st, Clerkenwell, London, E.C.

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See also page 300

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See also page 300.

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See also page 300.

Y

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Complete Particulars of Telegraphic Addresses and Telephone Numbers of the Firms included in the CLASSIFIED SECTION *will be found in the* ALPHABETICAL SECTION.

The Officials of Electrical Companies, where obtainable, are set out in pages 274 to 300, where also will be found all ascertainable particulars relating to the capital, dividends paid, and closing quotations of Stock for 1892 and 1893.

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Sherborne Electric Installation, Sherborne, Dorset

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HODGES & TODD, 82, Turnmill-st, London, E.C.
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NALDER BROS. & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 499**
NALDER & HARRISON, Trafalgar House, Great Newport-st, Charing Cross-rd, London, W.C. **See Advt., p. 523**
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GLOVER (W. T.) & CO, Salford, Manchester; and Albany-bldgs, 39, Victoria-st, London, S.W. **See Advt., p. 40**
Telegraph Manufacturing Company, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.
For single and metallic circuits; insulated with Gutta-Percha, Vulcanised Indiarubber, Compound Indiarubber, or pure Indiarubber; lead-covered or armoured. Aerial Cables a speciality.
Western Electric Company, 79, Coleman-st, London, E.C.

ANTIMONY REFINERS AND DEALERS.

(*See* **Metal Refiners.**)

ARBITRATORS, ELECTRICAL AND MECHANICAL.

KIRK (WHEATLEY), PRICE & GOULTY, 49 Queen Victoria-st, London. E.C.; and Albert-chambers, Albert-sq, Manchester.

ARC LAMP FITTINGS, MAKERS OF.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Arc Lamp Globes, Enamelled Shades and Casings, Resistance Frames, Reflectors, Switches and Winches.
BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, S.E., London
DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocers' Hall-ct, Poultry, London, E.C. **See Advt., p. 11**
Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570, and 572**
ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st, London, E.C.; and Wolverhampton
GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham, and Manchester. **See Advt., p. 486**
WATERHOUSE ELECTRICAL MANUFACTURING COMPANY, Limited, 67, Southwark Bridge-rd, London, S.E. **See Advt. on next page**

ARC LAMP PILLARS, MAKERS OF.

(*See also* **Lamp Post Manufacturers**).

Baxendale & Co, Miller-st, Manchester; and Edinburgh
BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, S.E., London
Falkirk Iron Company, Falkirk, N.B., and 67, Upper Thames-st, London, E.C.
SPENCE, WILFRID L., Assoc.M.Inst.C.E., The Elms, Seymour-grove, Manchester, S.W.
Speciality: Patent Safety Arc Lamp Standard, with Telescopic Climbing Gear.
WATERHOUSE ELECTRICAL MANUFACTURING COMPANY, Limited, 67, Southwark Bridge-rd, London, S.E. **See Advt. on next page**
Smith (George) & Co, Sun Foundry, Glasgow; and 199, Upper Thames-st, London, E.C.

ARC LAMPS, MAKERS OF.

Andersen — Girdlestone, Tatham & Co., 16, Davies-st, Berkeley-sq, London, W.
Andrews—Mavor & Coulson, 57, West Nile-st, Glasgow
——Andrews (J. D. F.) & Co, 15, Marsham-st, Westminster, London, S.W.
Barton, Thomas, Ainsworth-st, Blackburn
Baxendale & Co, Miller-st, Manchester; and Edinburgh
Bishop's Cluster Company, Limited, 147, Aldersgate-st, London, E.C.
BROCKIE-PELL — Johnson & Phillips, 14, Union-ct, Old Broad-st, E.C.; and Victoria Works, Charlton, S.E., London. **See Advt., p. 3**
BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, S.E., London

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The WATERHOUSE ARC LAMP

PERFECTLY NOISELESS.

THE CHEAPEST, MOST ECONOMICAL AND RELIABLE LAMP.
THOUSANDS IN USE.

THE WATERHOUSE ELECTRICITY METERS.

THE ONLY PERFECT METER IN THE MARKET.

SEND FOR PARTICULARS.

THE WATERHOUSE ELECTRICAL MANUFACTURING CO.,

67, SOUTHWARK BRIDGE ROAD, S.E.

And at 45, BROADWAY, NEW YORK ; & 302, ASYLUM STREET, HARTFORD, CONN., U.S.A

BYNG—General Electric Co, 69 and 71, Queen Victoria-st, London, E.C. ; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

Castle—Holmes (J. H.) & Co, Portland-rd, Newcastle-on-Tyne, and 17, Coleman-st, London, E.C.

Cathcart, Peto & Radford, 57B, Hatton-gdn, London, E.C.

Conrady—Conrady (Eugen) & Co, Keighley, Yorks.

CROMPTON—Crompton & Co, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

CROMPTON - POCHIN — Crompton & Co, Limited, Mansion House - bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advt., pp. 56 and 302, and inside back cover**

Crown—Crown Electric Light Company, 80, Queen Victoria-st, London, E.C.

ELECTRICAL INSTALLATION COMPANY, Limited, 64, Victoria-st, London, S.W.

ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st, London, E.C. ; and Wolverhampton

Falkirk Iron Company (R. W. Kennard & Co), 67, Upper Thames-st, London, E.C. ; and at Liverpool, Glasgow, and Edinburgh. Works: Falkirk, N.B.

Gulcher—Gulcher (New) Electric Light and Power Company, Limited, Battersea Foundry, London, S.W.

Harp—Chester & Rathbone, 9, Grosvenor-gdns, Ealing, London, W.

HINDLEY, E. S., 11, Queen Victoria-st, London, E.C., and Bourton, Dorset. **See Advts., p. 553, &c.**

Headech—Headech, E. T., 61, Falmouth-rd, New Kent-rd, London, S.E.

LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, 64, Millbank-st, S.W., and 11, Abchurch-lane, E.C., London. **See Advt., p. 602**

London Arc Lamp Co, 35, Grafton-st, Fitzroy-sq, London, W.

LUNA—Electrical Company, Limited, 122 and 124, Charing Cross-rd, London, W.C. **See Advt., p. 539**

Lundberg, A. P., Bradbury Electrical Works, Bradbury-st, Kingsland, London, N.E. **See Advt., p. 619**

Merveilleuse—Merveilleuse Electric Arc Lamp Syndicate, Limited, 9, New Broad-st, London, E.C.

Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

NEWTON—Newton Electrical Engineering Works, Taunton

Paragon Electric Company, 26, Garlick-hill, London, E.C.

PHŒNIX DIFFERENTIAL—Paterson and Cooper, European Works, Pownall-rd, Dalston, N.E., and 3, Princes-mansions, S.W., London ; and 137, West Regent-st, Glasgow. **See Advt., p. 39**

Pilsen — Pilsen Electric Company, Messrs. Gwynne & Co, Brooke-street Works, Holborn, London, E.C.

Pilsen Joel—Joel (H. F.) & Co, 31, Wilson-st, Finsbury, London, E.C.

PLANET—Planet Electrical Engineering Company, Limited, 28, Victoria-st, S.W., and 57, Piccadilly, W., London ; and 150A, North-st, Brighton

Richardson—Richardson Arc Lamp Co, Patricroft, Manchester

ROYCE (F. H.) & CO, Cooke st, Hulme, Manchester. (*Switch Manchester, Nat. 772*)

Short—Rosling & Matthews, Trafalgar-rd, Bradford, and Porter-st, Hull

SIEMENS—Siemens Bros & Co, Ltd, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**

Silvertown—India Rubber, Gutta Percha and Telegraph Works Company, Limited, 106, Cannon-st, London, E.C., and Silvertown, Essex

SIMPLEX—Consolidated Telephone Construction and Maintenance Company, Limited, 109, Farringdon-road, London, E.C. **See Advt., p. 629**

Soho—Wray Electrical Engineering Co, Soho Works, Thornton-rd, Bradford

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TELEGRAPH MANUFACTURING COMPANY, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.
Lamps and Fittings, Cables, Posts, Insulators, Mains and Flexibles, Telegraph and Telephone Equipments, Incandescent Lamps, Holders and Fittings, and Switchboards.

TALENTA—Goolden (W. T.) & Co, Woodfield Works, Harrow-rd, London, W.

THAMES—Thames Iron Works and Shipbuilding Company, Ltd, Orchard-yd, Blackwall, London, E. **See Advt. inside back cover**

THOMSON-HOUSTON—Laing, Wharton & Down, 82A, New Bond-st, W., and 17, Gracechurch-st, E.C., London; and Guardian-bldg, Manchester. **See Advt., p. 40**

Tiffin, F. J., 3, Great Winchester-st, London, E.C.

Tyne—Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.

Universal—Universal Arc Lamp Syndicate, Limited, 4, Arthur-st, New Oxford-st, London, W.

WATERHOUSE ELECTRICAL MANUFACTURING COMPANY, Limited, 67, Southwark Bridge-rd, London, S.E. **See Advt., p. 443**

WESTINGHOUSE—Westinghouse Electric Company, Limited, 32, Victoria-st, London, E.C. **See Advt., p. 487**

WESTMINSTER—Clark (Latimer), Muirhead & Co, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**

Weston—London & Lancashire Electric and General Engineering Co, Limited, Kingsland-green, Dalston, London, N.E.

ARMATURES FOR DYNAMOS, MAKERS OF.

Barton, Thomas, Electric Works, Blackburn (*Barton Blackburn, 265*)

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C.; and 112, Belvedere-rd, S.E., London

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st, London, E.C.; and Wolverhampton

Hall (J. P.) & Co, Blackriding Iron Works, Werneth, Oldham

LAURENCE, SCOTT & CO, Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**

MacCarthy, C. C., 23, Corporation-st, and William-st South, Belfast. **See Advt., p. 49**

MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chmbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**

NEWTON ELECTRICAL ENGINEERING WORKS, Taunton

Paterson & Cooper, European Works, Pownall-rd, Dalston, N.E.; and 68, Victoria-st, S.W., London. **See Advt., p. 39**

Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-upon-Tyne; and 5, Crown-ct, Cheapside, London, E.C.

Sherborne Electric Installation, Sherborne, Dorset

ARMATURE CABLES AND WIRES, MAKERS OF.

(*See also* **Electric Cables and Wires, &c.**)

CONNOLLY BROS, Blackley, Manchester. (*Connollys Manchester, 2361*) **See Advt., p. 475**

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

GLOVER (W. T.) & CO, Salford, Manchester; and Albany-bldgs, 39, Victoria-st, London, S.W. **See Advt., p. 40**

ARMOURED CABLES AND WIRES, MAKERS OF.

(*See also* **Electric Cables and Wires, &c.**)

CALLENDER'S BITUMEN, TELEGRAPH & WATERPROOF COMPANY, Limited, 101, Leadenhall-st, London, E.C.; and at Liverpool, Birmingham, Huddersfield, Dundee, and Kelvinside. Works: Erith, Kent

CONNOLLY BROS., Blackley, Manchester (*Connollys Manchester, 2361*). **See Advt., p. 475**

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

FOWLER-WARING CABLES COMPANY, Limited, 32, Victoria-st, London, S.W.; and North Woolwich. **See Advts., pp. 302 and 475**

GLOVER (W. T.) & CO., Salford, Manchester; and Albany-bldgs, 39, Victoria-st, London, S.W. **See Advt., p. 40**

SIEMENS BROS. & CO., Limited, 12, Queen Anne's Gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover.**

ART FITTINGS (ELECTRIC LIGHT), MAKERS OF.

(*See also* **Electric Light Fittings.**)

Baxendale & Co, Miller-st, Manchester; and Edinburgh

BENHAM & FROUD, Limited, 40, Chandos-st, Strand, London, W.C.

BENSON (W. A. S.) & Co, 82 and 83, New Bond-st, and 2, Dering-st, London, W.

DAVIS (J.) & SON, All Saints Works, Derby; and 118, Newgate-st, London, E.C.

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

Edwards (W. J.) & Co., 10, 11 and 12, Cecil-st, Birmingham; and 31, Holborn-viaduct, London, E.C.

Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.

ELECTRICAL COMPANY, Limited, 122 and 124, Charing Cross-rd, London, W.C. **See Advt., p. 539**

EVERED & CO, Limited, 27-31, Drury-lane, W.C., 143, High-st, Shoreditch, E., and 50, Holborn-viaduct, E.C., London; and Surrey Works, Smethwick. **See Advt., p. 38**

Faraday & Son, 3, Berners-st, London, W.

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PERRY & CO.,
17, GRAFTON STREET,
BOND ST., LONDON.

FINEST DESIGNS
AND
BEST WORK.

CATALOGUES.

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

Guthrie (James) & Co, 9, Leather-lane, and 117, Holborn, London, E.C.

LAING, WHARTON & DOWN, 82A, New Bond-st, W., and 17, Gracechurch-st. E.C., London; and Guardian-bldgs, Manchester. **See Advt., p. 42**

OSLER, F. & C., 230, Broad-st, Birmingham; and 100, Oxford-st, London, W.C.

PERRY & CO, 17, Grafton-st, Bond-st, London, W. **See Advt. above and pp. 483, 547, and 598**

STATTER (J. G.) & CO., Limited, 68, Victoria-st, S.W., and Millwall, E., London. (Telegrams: *Statter London*. Telephone No. *3158*) **See Advt., p. 471**

Tayler Smith Electric Company, Limited, 53, South Molton-st, London, W.

VAUGHAN & BROWN, 16 and 17, Kirby-st, and 19, Farringdon-rd, London, E.C. **See Advt., p. 488**

VERITY (B.) & SONS, 31 and 32, King-st, Covent Garden, W.C., and 137, Regent-st, W., London; Plume Works, Aston, Birmingham; and 29, Princes-st, Manchester

ART METAL WORKERS.

Adshead & Smellie, Ivanhoe Works, Oxford-st, Dudley

Allen (W. T.) & Co, 132, Queen Victoria-st, London, E.C.

Andrews & Co, 71, 224 and 226, Tottenham Court-rd, London, W.

Baily (William) & Son, 71, Gracechurch-st, London, E.C.

Barnard, Bishop and Barnards, Limited, 91–95, Queen Victoria-st, London, E.C., and at Norwich

Baxendale & Co, Miller-st, Manchester, and Edinburgh

BENHAM & FROUD, Limited, 40, Chandos-st, Strand, London, W.C.

Benton & Stone, Aston Brook Tube Mills, Birmingham.

BEREND (O.) & CO., 61, Fore-st, London, E.C. (*Yttrium, London*).

Artistic Hand-forged Iron, also Brass and Bronze Ware, made to Design

Billing & Co, Limited, Smart's-bldgs, High Holborn, London, W.C.

Bull, F. P., 226½, High Holborn, London, W.C.

Caslake, James, 152, Kentish Town-rd, London, N.W.

Cluse, William, 187, Tottenham Court-rd, London, W.C.

Cope & Collinson, 53, Berwick-st, Oxford-st, London, W.; and 61, Summer-row, Birmingham

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

Edwards (W. J.) & Co., 10, 11 and 12, Cecil-st, Birmingham; and 31, Holborn-viaduct, London, E.C.

Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.

Elsley, Thomas, 32, Great Portland-st, London, W.

EVERED & CO. Limited, 27-31, Drury-lane, W.C., 143, High-st, Shoreditch, E., and 50, Holborn-viaduct, E.C., London; and Surrey Works, Smethwick. **See Advt., p. 38**

Gawthorp, T. J., 16, Long-acre, London, W.C. (To the Prince of Wales)

Hart, Son, Peard & Co, Limited, 88 to 91, Drury-lane, Strand, London, W.C.; and Grosvenor Works, Birmingham

Jessop & Son, 19, Knowsley-rd, Battersea, London, S.W.

Johns, C. W., 230, Upper-st, London, N.

Jones & Willis, 43, Great Russell-st, and 33, Duke-st, Bloomsbury, London, W.C.

Keeling (Edgar), Teale & Co, 14, Elm-st, Gray's Inn-rd, London, W.C.

LAING, WHARTON & DOWN, 82A, New Bond-st, W., and 17, Gracechurch-st, E.C., London; and Guardian-bldgs, Manchester. **See Advt., p. 40**

Longden & Co, 447, Oxford-st, London, W.; and Phœnix Foundry, Sheffield.

Milne, Sons and Macfie, 60, Holborn-viaduct, London, E.C.; and Edinburgh

PERRY & CO, 17, Grafton-st, Bond-st, London, W. **See Advt. above, and pp. 483, 547, and 598**

Piskorski (W.) & Co, 49, Red Lion lane, Hammersmith, London, W.

Pratt (T.) & Sons, 22-24, Tavistock-st, Covent-gdn, London, W.C.

Pridmore, Geo. W., 2, Broad-st-bldgs, Liverpool-st, London, E.C.

Rock, Charles M., 106, Gt. Russell-st, London, W.C.

Sambidge (H. W.) & Son, Highgate-st, Birmingham

Slater (James) & Co, 251, High Holborn, London, W.C.

Smith (Charles) & Sons, 12, Oxford-circus-avenue, London, W.; and Birmingham and Liverpool

Soutter (W.) & Sons, Farm Street Works, Birmingham; and 47, Holborn-viaduct, and 49, Farringdon-st, London, E.C.

Taylor & Tucker, Art Metal Company, Limited, 9, Duke-st-mansions, Grosvenor-sq, and Harlesden, W., London

Tonks, Limited, 201, Moseley-st, Birmingham; and 57, Holborn-viaduct, London, E.C.

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TOWNSEND & McINTYRE, 15, Brook-st, W., and 189, Drummond-st, Euston-rd, N.W., London
Townshend & Co, Ernest-st, Birmingham, and 62, Holborn-viaduct, London, E.C,
VERITY (B.) & SONS, 31 and 32, King-st, Covent Garden, W.C., and 137, Regent-st, W., London; Plume Works, Aston, Birmingham; and 29, Princes-st, Manchester
Waltham Electrical Engineering Company, Chapel-place Works, Great Chapel-st, Westminster, London, S.W. (*Switchboard London*)
Winfields, Limited, Cambridge-st Works, Birmingham; and 49, Farringdon-st, London, E.C.

ARTESIAN WELL ENGINEERS.

Abyssinian Tube Wells Company (Le Grand & Sutcliff), 125, Bunhill-row, London, E.C.
Batchelor, Richard D., 73, Queen Victoria-st, London, E.C., and Chatham
Isler (C.) & Co, Artesian Works, Bear-lane, and Edward-st, Southwark, London, S.E.

ASBESTOS MERCHANTS AND MANUFACTURERS.

Attwater (R. H.) & Sons, Preston, Lancs.
Bates, Arthur, 31, Dutton-st, Manchester
Baxendale & Co. Miller-st, Manchester; and Edinburgh
Beldam Packing & Rubber Co, 77, Gracechurch-st, London, E.C.
Bell's Asbestos Company, Limited, 59½, Southwark-st, London, S.E.
British Asbestos Company, 12 and 16, Duke-st, Aldgate, London, E.C.
Brooks & Walker, 18, London-st, London, E.C.
Cresswell (D. G.) & Son, Wellington Mills, Bradford, Yorks.
Dick's Asbestos Company, 2 and 4, Trinity-st, Canning Town, London, E.
Fitt Bros. & Davies, 17, Wind-st, Swansea
HATCH, GEORGE, Crown Wharf, 5, Upper Thames-st, London, E.C.
London Asbestos Co, 101, Leadenhall-st, London, E.C.
MOSELEY (DAVID) & SONS, Chapel Field Works, Ardwick, Manchester; and at London and Glasgow. **See Advt., p. 56**
TURNER BROS., Spotland, Rochdale
United Asbestos Company, Limited, 34, Deansgate, Manchester; and Dock House, Billiter-st, London, E.C.
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**
WITTY & WYATT, Limited, 88, Leadenhall-st, London, E.C.

ASBESTOS-PACKED STEAM FITTINGS MANUFACTURERS.

DEWRANCE & CO, 158, Great Dover-street, London, S.E.
WILLCOX (W. H.) & CO., 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**
WITTY & WYATT, Limited, 88, Leadenhall-st, London, E.C.

ASPHALTE FOR BATTERY-ROOM PURPOSES.

Pilkington & Co, Monument-chbrs, King William-st, London, E.C.
Rochdale Ashphalte and Concreting Company, Walker-st, Rochdale, Lancashire

ASPHALTE FOR CONDUITS, MAKERS OF.

CALLENDER'S BITUMEN, TELEGRAPH & WATERPROOF COMPANY, Limited, 101, Leadenhall-st, London, E.C.; Oldham-pl, Renshaw-st, Liverpool; Cannon-passage, Birmingham; and Erith, Kent

ASSAYERS.

Johnson & Matthey, Limited, Hatton-garden, London, E.C.
Polglase & Co, Tyne Vale Chemical Works, Skinnerburn-rd, Forth Banks, Newcastle-on-Tyne

ASSOCIATIONS (*see* Societies and Institutions).

AUCTIONEERS, ELECTRICAL AND MECHANICAL.

(*See also* **Arbitrators and Valuers.**)

Brown, Bradshaw, Billiter-sq-bldgs, Billiter-sq, E.C., and 173, West Ferry-rd, E., London
HUDDLESTON, PERCY, 21, Upham-park-rd, Chiswick, London, W.; and at Manchester
KIRK (WHEATLEY), PRICE & GOULTY, 49, Queen Victoria-st, London, E.C.; and Albert-sq, Manchester
Sherley-Price, Henry (Wheatley Kirk, Price and Goulty), 49, Queen Victoria-st, London, E.C.

AUTOMATIC CUT-OUTS, MAKERS OF.

(*See also* **Cut-Outs.**)

BARTON, THOMAS, Electric Works, Blackburn (*Barton Blackburn, 265*)
BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.
DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocers'-hall-court, Poultry, London, E.C. **See Advt., p. 11**
DUTTON & CO, Limited, Railway Signal Works, Worcester; and 70 and 71, Palace-chmbrs, Westminster, London, S.W.
Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570, and 572**
Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.
ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt. on back cover**
LAURENCE, SCOTT & CO, Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**
NALDER BROS. & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 499**
NEWTON ELECTRICAL ENGINEERING WORKS, Taunton
Sherborne Electric Installation, Sherborne, Dorset

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AUTOMATIC ELECTRIC SIGNALLING APPARATUS MAKERS.

(*See also* **Electric Signalling Apparatus Makers.**)

Automatic Electric Railway Signal Company, Limited, 11, Rumford-pl, Liverpool. (Patentees)

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Signalling Apparatus of every description.

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W.; and Woolwich. **See Advt. inside front cover**

AUTOMATIC MACHINES, MAKERS OF.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Contractors for Complete Supplies and Apparatus.

Keighley Electrical Engineering Company, Limited, Bow-st, Keighley, Yorkshire

Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

AUTOMATIC POTENTIAL REGULATORS, MAKERS OF.

(*See also* **Regulators.**)

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

DUTTON & CO, Limited, Railway Signal Works, Worcester; and 70 and 71, Palace-chmbrs, Westminster, London, S.W.

ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt. on back cover**

GOOLDEN (W. T.) & CO, Woodfield Works, Harrow-rd, London, W.

ROYCE (F. H.) & CO, Cooke-st, Hulme, Manchester (*Switch Manchester, Nat. 77?*)

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

BALLOONS (Electrical), EXPERT IN.

BRUCE, ERIC S., 10, Observatory-avenue, Kensington, London, W.

BAROMETER MAKERS.

(*See also* **Meteorological Instrument Makers.**)

BARKER (FRANCIS) & SON, 12, Clerkenwell-rd, London, E.C. **See Advt., p. 462**

BATTERIES, MAKERS OF AND DEALERS IN.

General.

BARTON, THOMAS, Electric Works, Blackburn (*Barton Blackburn, 265*)

Carbon Battery Company, Limited, 10, Mildmay-chmbrs, 7, Union-court, Old Broad-st, London, E.C.

Carbone, Le (late Lacombe & Co), 7, Carteret-st, Westminster, London, S.W.

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570, and 572**

Harrison, Coles & Co, Hermitage Electrical Works, Richmond, Surrey; and 20, Kensington Court-pl, London, W.

LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, 64, Milbank-st, S.W. and 11, Abchurch-lane, E.C., London. **See Advt., p. 602**

Dry.

Baxendale & Co, Miller-st, Manchester; and Edinburgh

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

Block—Henley's (W. T.) Telegraph Works Company, Limited, 27, Martin's-lane, Cannon-st, London, E.C.

CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**

Crown—Nehmer Bros, 27, Sekforde-st, Clerkenwell, London, E.C.

E.C.C.—Electric Construction Corporation, Ltd, Worcester House, Walbrook, London, E.C.

Excelsior—Southey, H. E., 37, Crouch End-hill, London, N.

Fentum—Phillips, H. Fentum, Stoke, Guildford

Ford-Lloyd Manufacturing Company, 2-8, Mount Pleasant, London, W.C.

Gent & Co, Faraday Works, Leicester; 3, Maiden-lane, Queen-st, London, E.C.; 47, High Bridge, Newcastle-upon-Tyne; 27, Oswald-st, Glasgow; and at Cardiff and Belfast

HELLESEN—Siemens Bros and Co, Limited, 12, Queen Anne's-gate, Westminster, London, S.W.; and Woolwich. **See Advt. inside front cover**

LECLANCHÉ—Leclanché & Co (Sole Agent, R. Aylmer), 47, Victoria-st, London, S.W. (*Leclanché London*). **See Advt., p. 17**

Monarch—Baughan & Co, Charlbury

Pearce, A. E., High-st, Southwold

Sherborne Electric Installation, Sherborne, Dorset

Williams (F.), 48, Northampton-st, Clerkenwell, London, E.C.

Galvanic.

CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**

Cohen (Louis) & Co, Central Beach, Blackpool

Croggon & Co, Limited, 16, Upper Thames-st, London, E.C.; 19, Tithebarn-st, Liverpool; and 7, John-st, Glasgow

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GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C.; and Victoria Works, Charlton, Kent. **See Advt. p. 3**

Richardson (J. R.) & Son, Harrison, Aspatria, Carlisle

Sherborne Electric Installation, Sherborne, Dorset

Primary.

Baxendale & Co, Miller-st, Manchester; and Edinburgh

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)

Berliner's Telephone Battery and others.

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

BRISTOL ELECTRIC SAFETY LAMP WORKS, 63, Queen Victoria-st, London, E.C. **See Advt., p. 601**

CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**

Crescent—Ingersoll-Sergeant Drill Company, 114A, Queen Victoria-st, London, E.C.

Emery—Howarth, J. R., 243, Pentonville-rd, King's Cross, London, N.

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

HIGGINS—Johnson & Phillips, 14, Union-ct, Old Broad-st, E.C., and Victoria Works, Charlton, S.E., London. **See Advt., p. 3**

HOLMES-BURKE—Johnson & Phillips, 14, Union-ct. Old Broad-st, E.C., and Victoria Works, Charlton, S.E., London. **See Advt., p. 3**

LAING, WHARTON & DOWN, 82A, New Bond-st, and 17, Gracechurch-st, E.C., London; and Guardian-bldg, Manchester. **See Advt., p. 42**

LECLANCHÉ—Leclanché & Co. (sole Agent, R. Aylmer), 47, Victoria-st, London, S.W. (*Leclanché London*). **See Advt., p. 17**

——— Leclanché Battery Company, New York, U.S.A. **See Advt. above**

LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, 64, Millbank-st, S.W., and 11, Abchurch-lane, E.C., London. **See Advt., p. 602**

London and Hampstead Battery Company, Limited, 15A, Fitzjohn's-pavement, Finchley-rd, London, N.W.

Mackey—Mackey, Mackey & Co., Bouverie-st, London, E.C.

Maquay—Maquay Electric Light Company, 180, Wardour-st, London, W.

Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

PITKIN, JAMES, 56, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 491**

Revolving—Rawlins, T. D., High-st, Lymington

Robertson—Robertson & Co., 234, Sauchiehall-st, Glasgow

Sherborne Electric Installation, Sherborne, Dorset.

SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W.; and Woolwich **See Advt. inside front cover**

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Wright, Archibald, J., 52, Cromwell-avenue, Highgate, London, N.

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Arc Accumulator Company, Limited, 99, Cheapside, London, E.C.

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

BRISTOL ELECTRIC SAFETY LAMP WORKS, 63, Queen Victoria-st, E.C.; and 40, Great Smith-st, Westminster, S.W., London. **See Advt., p. 601.**

CHLORIDE ELECTRICAL STORAGE SYNDICATE, Limited, 8, King-st, Manchester

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CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**

Crompton-Howell—Crompton-Howell Electrical Storage Company, Mansion House-bldgs, London, E.C.; and New Dock, Llanelly

D.P.—Johnson and Phillips 14, Union-ct, Old Broad-st, London, E.C. **See Advt. p. 3.**

——— Drake & Gorham, 66, Victoria-st, London, S.W. **See Advt., p. 15**

E.P.S.—ELECTRICAL POWER STORAGE COMPANY, LIMITED, 4, Great Winchester-st, London, E.C.

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See Advt. on back cover

Elieson—Lamina Accumulator (Elieson's British Patent) Syndicate, Limited, Broad-st-avenue, London, E.C.

Ernst—Miller, W., 83, Park-end, Bromley, Kent

EPSTEIN—Epstein Electric Accumulator Company, Limited, 21a, Blythe-rd, West Kensington, W. (*Peroxide London*), and 19 and 213, Gresham-house, Old Broad-st, E.C. (*Alchymist London*), London. **See Advt. above**

Foreign and Colonial Arc Accumulator Company, Limited, 99, Cheapside, E.C.

Hurst (A.) & Co., 6, Fowkes-bldgs, Great Tower-st, E.C.

James—Miller, W., 83, Park-rd, Bromley, Kent

Kennedy—Kennedy Storage Battery Company, Limited, Broad-street House, Old Broad-st, London, E.C.

Law—Mackey, Mackey & Co., 1, Bouverie-st, London, E.C.

MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. (*Mather Manchester; Bath-metal London*)

McLachlan, E. A., 55, Brighton-rd, Stoke Newington, London, N.

PITKIN, JAMES, 56, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 491**

PRITCHETTS & GOLD, 31, Soho-sq, W., and Woolwich, S.E., London

Sherborne Electric Installation, Sherborne

BATTERIES, STORAGE, EXPERTS IN.

ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt. on back cover.**

Epstein, L., 21A, Blythe-rd, West Kensington, London, W.

Sherborne Electric Installation, Sherborne

BATTERY JARS, MAKERS OF.

(*See also* **Insulator and Battery Jar Makers.**)

Allen, William, Benthall Pottery, Broseley, Salop

Bishop's Cluster Company, Limited, 147, Aldersgate-st, London, E.C.

BOURNE (JOSEPH) & SON, New St. Pancras Station, Euston-rd, London, N.; and Denby Pottery, near Derby. **See Advt., p. 580.**

DOULTON & CO, Lambeth Pottery, London, S.E. **See Advt., p. 579.**

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 594, 547, 570 and 572**

Espir, Fernand, 3, East India-avenue, London, E.C.

HARBURG INDIA RUBBER C. COMPANY, 138, London-wall, London, E.C. **See Advts., pp. 471, 576 and 642**

Hardcastle, W. H., 172, Alexandra-road, Sheffield

Kirkhams, London-rd, Stoke-on-Trent

LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, 64, Milbank-st, S.W., and 11, Abchurch-lane, E.C., London. **See Advt., p. 602**

PRICE, SONS & CO, The Potteries, Bristol, and 113, Midland-rd, St. Pancras, London, N.W. **See Advt., p. 580**

STIFF (J.) & SONS, London Pottery, Lambeth, London, S.E. **See Advt., p. 579**

WINTER, F., 138, London-wall, London, E.C. **See Advts., pp. 471, 576 and 642**

BATTERY PLATES, MAKERS OF.

(*See also* **Carbon Rods and Battery Plates.**)

BRISTOL ELECTRIC SAFETY LAMP WORKS, 63, Queen Victoria-st, London, E.C. **See Advt., p. 601**

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Carbone Le (late Lacombe & Co), 7, Carteret-st, Westminster, London, S.W.
CHAMBERLAIN, H. & F., Barnsley, Yorks. **See Advt., p. 17**
Conradty, C., 28, 29 and 30, Paternoster-row, London, E.C.
Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570, and 572**
ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt. on back cover**
LECLANCHÉ & CO (Sole Agent, R. Aylmer), 47, Victoria-st, London, S.W. (*Leclanché London*) **See Advt., p. 17**
LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, 64, Milbank-st, S.W., and 11, Abchurch-lane, E.C., London. **See Advt., p. 602**
Mayer, H., 28, 29 and 30, Paternoster-row, London, E.C.
PITKIN, JAMES, 56, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 491**
Sherborne Electric Installation, Sherborne, Dorset

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"Tempered" Copper Bearings to order.
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BARTON, THOMAS, Electric Works, Blackburn (*Barton Blackburn, 265*)
Baxendale & Co., Miller-st, Manchester; and Edinburgh
BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.
GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**
HARRIS (A. & E.) & CO, 95, Camden-st, Birmingham
Heckford & Robinson, 78, Parade, Birmingham
Sheppard, Allerton & Madeley, Clement-st, Birmingham
Sherborne Electric Installation, Sherborne
Smith (S.) & Son, 9, Strand, London, W.C.
Sykes, Alfred, Turnbridge, Huddersfield

BELLS, ELECTRIC (*see* **Electric Bells**).

BELT STAPLERS AND STAPLES, MAKERS OF.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
FLEMING, BIRKBY & GOODALL, Limited, West Grove Mill, Halifax. **See Advts., pp. 466 and 616.**

BELTING MANUFACTURERS.

(*See also* **Driving Band Makers.**)

BAGSHAWE BROS & CO, 4A, Upper Thames-st, London, E.C. **See Advts., pp. 606 and 617**
Bates, W. & A., St. Mary's Mills, Leicester; and 121, Stamford-st, London, S.E.
Brown (G. R.) & Co, 41, St. Mary-axe, London E.C.
Cockill, Henry F., Mount View Leather Works, Cleckheaton.
Cort (A). & Co, 277, Camberwell New-rd, London, S.E.
Fenner (J. H.) & Co, Devonshire Chambers, Bishopsgate-st, London, E.C.; and Hull
Fenton Bros., Lanark, N.B.
FLEMING, BIRKBY & GOODALL, Limited, West Grove Mill, Halifax. **See Advts., pp. 466 and 616**
Haagen (T. H.) & Son, 60, St. Mary-axe, London, E.C.
Hilton (F.) & Co, Castleton, nr Manchester
Icke (Thomas) & Son, Heath Leather Works, West Bromwich
Mayger (W. J.) & Co, Burton-on-Trent
MOSELEY (DAVID) & SONS, Chapel Field Works, Ardwick, Manchester; and at London and Glasgow. **See Advt., p. 56**
NAYLER, JOHN, 200, High-st, Dudley
RAWLINGS (S.) & SON, South-parade Works, Frome; and 9, Gracechurch-st, London, E.C.
Reddaway (F.) & Co, Limited, Pendleton, Manchester
SAMPSON & CO, Stroud. **See pp. 410 and 467**
Selig, Sonnenthal & Co, 85, Queen Victoria-st, and Lambeth-hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7.**
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

BICHROMATE SALTS, SOLID, MANUFACTURERS OF.

BOOR (G.) & CO, 1 and 2, Artillery-lane, Bishopsgate-st, London, E.C. **See Advt., p. 440**

BLOCK AND TACKLE FALL MANUFACTURERS.

WILLCOX (W. H.) & Co, 34 & 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1.**

BLOWPIPES, MAKERS OF

Buck & Hickman, 280 and 281, Whitechapel-rd, London, E.
PROBERT, W., Whately-rd, Handsworth, Birmingham. **See Advt. below**

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Babcock & Wilcox, Limited, 147, Queen Victoria-st, London, E.C.; 21, Bothwell-st, Glasgow; and 28, Mawson-chmbrs, Deansgate, Manchester.
Barlow, J. & W., Crawford-st, Rochdale
BELLISS (G. E.) & CO, Limited, Ledsam-street Works, Birmingham; and 9, Victoria-st, London, S.W. **See Advt., p. 558**
BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, Lambeth, S.E., London
Burnet, Lindsay, & Co, Moore Park Boiler Works, Govan
Clarke & Co, Forest-rd, Nottingham
Cochran & Co, 54, Duke-st, Birkenhead; and Bidston Wharf, Bidston
Copeland (J.) & Co, Pulteney-st Engine Works, Dobbies Loan, Glasgow; and 101, Leadenhall-st, London, E.C.
Cornwall Boiler Company, Limited, Camborne, Cornwall
Cradley Boiler Company, Cradley Heath, near Birmingham; and 113, Leadenhall-st, London, E.C.
DAVEY, PAXMAN & CO, Colchester; and 78, Queen Victoria-st, London, E.C. **See Advt., p. 51**
Davy Bros, Limited, Park Iron Works, Sheffield
Fraser & Fraser, Monument-chambers, King William-st, London, E.C.
Galloways, Limited, Knott Mill Iron Works and Branch Iron Works, Ardwick, Manchester; and 64, Cannon-st, London, E.C.
Garret (R.) & Sons, Leiston Works, Suffolk
Hall, J. & E., 23, St. Swithin's-lane, London, E.C.
Hartley & Sugden, Limited, Atlas Boiler Works, Halifax
Hayes, Edward, Limited, 12, Great St. Helen's, London, E.C.; and Stony Stratford
HINDLEY, E. S., 11, Queen Victoria-st, London, E.C.; and Bourton, Dorset. **See Advts., pp. 553, &c.**
Horsfield, J. & J., Dewsbury
Knap (Conrad) & Co, Lincoln; and 11, Queen Victoria-st, London, E.C.
Marshall, Sons & Co, Limited, Gainsborough, Lincolnshire; and 79, Farringdon-rd, London, E.C.
Morton (S. & H.) & Co, Victoria Dock, Leith
Nicholson (Alex.) & Co, Crown Point Boiler Works, Glasgow
Oldham Boiler Works Company, Limited, Oldham, Lancs.
Olrick (Lewis) & Co, 27, Leadenhall-st, London, E.C.
Rait & Gardiner, 155, Fenchurch-st, E.C., and Millwall Docks, E., London
Robey & Co, Limited, Lincoln; and 117, Cannon-st, London, E.C.
Rose, Downs, & Thompson, Limited, Old Foundry, Hull
Ross (James) & Son, National Boiler Works, Old Kent-rd Station, London, S.E.
Ross & Walpole, North Wall Iron Works, Dublin.
Smedley Bros, Limited, Belper, Derbyshire.
Stevenson & Davies, 11, Queen Victoria-st, London, E.C.
THOMPSON, JOHN, Ettingshall, Wolverhampton; and 73, Queen Victoria-st, London, E.C.
Thompson Bros, Bradley Boiler Works, Bilston; and 9, Ducksfoot-lane, London, E.C.
Walker, Batt, & Phillips, Victoria Iron Works, Ringwood, nr Bristol.
Warner (Robert) & Co, 27, Jewin-crescent, London, E.C.; and Engineering Works, Walton-on-the-Naze, Essex
Watt (J.) & Co, 90, Leadenhall-st, London, E.C.
Weeks (J.) & Co, King's-rd, Chelsea, London, S.W.
YOUNGS, Ryland-street Works, Birmingham

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Bruce (R. T.) & Co, 5, Commercial-rd, Hull
Kirkaldy (John) & Son, East London Works, Garford-st, London, E.C.
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WADE (J. L.) & CO, Limited, Contractors to H.M. Government, War Office, Indian Store Department, London County Council, &c., Manor House Wharf, Nine Elms-lane, London, S.W.
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

BOLTS, SCREWS, NUTS, &c., MAKERS OF.

ATKINS (CHAS.) & NISBET, 1, Water-lane, Great Tower-st, London, E.C. **See Advt., p. 634.**
AUTOMATIC STANDARD SCREW COMPANY, Halifax. **See Advts., pp. 611 and 634.**
Barwell (W.) & Sons, Brookfield, Birmingham; and 26, Martin's-lane, Cannon-st, London, E.C.
BEREND (O.) & CO, 61, Fore-st, London, E.C.
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Newbold (Walter) & Co, 1A, Lawrence Pountney-hill, London, E.C.
Periam, Herbert W., Floodgate-street, Birmingham
Selig, Sonnenthal & Co, 85, Queen Victoria-st, and Lambeth-hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7.**
Stokes (A.) & Co, Green-st, Deritend, Birmingham
WILLCOX (W. H.) & Co, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

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(*Yttrium London*)
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DRAKE & GORHAM, 66, Victoria-street, London, S.W. **See Advt., p. 15**

ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt. on back cover**

Epstein Electric Accumulator Company, Limited, 21A, Blythe-rd, West Kensington, W. (*Peroxide London*), and 213, Gresham House, Old Broad-st, E.C. (*Alchymist London*), London. **See Advt., p. 449**

HARBURG INDIA RUBBER C. COMPANY, 138, London-wall, London, E.C. **See Advts., pp. 471, 576, and 642**

HARRIS, J. F. & G., 58 and 60, Wilson-st, Finsbury, London, E.C. **See Advt., p. 455**

MOSELEY (DAVID) & SONS, Chapel Field Works, Manchester; and at London and Glasgow. **See Advt., p. 56**

Winter, F., 138, London-wall, London, E.C.

BRACKETS AND PENDANTS, MAKERS OF.

ANDREWS (J. D. F.) & CO, 15, Marsham-st, Westminster London, S.W.

Baxendale & Co, Miller-st, Manchester; and Edinburgh

BENHAM & FROUD, Limited, 40, Chandos-st, Strand, London, W.C.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
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BEST & LLOYD, Cambray Works, Handsworth, Birmingham; and 10, Bartlett's-buildings, Holborn-circus, London, E.C.
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DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester: and 11, Grocers' Hall-court, Poultry, London, E.C. **See Advt., p. 11**

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570, and 572.**

Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.

EVERED & CO, Limited, 27-31, Drury-lane, W.C., 143, High-st, Shoreditch, E., and 50, Holborn-viaduct, E.C., London; and Surrey Works, Smethwick. **See Advt., p. 38**

Hart, Son, Peard & Co, Limited, 88 to 91, Drury-lane, Strand, London, W.C.; and Grosvenor Works, Birmingham

MacCarthy, C. C., Belfast Electrical Works, 23 Corporation-sq, and William-st, South, Belfast. **See Advt., p. 49**

OSLER, F. & C., 230, Broad-st, Birmingham; and 100, Oxford-st, London, W.C.

PERRY & CO., 17, Grafton-st, Bond-st, London, W. **See Advts., pp. 445, 483, 547, and 598**

VERITY (B.) & SONS, 31 and 32, King-st, Covent Garden, W.C., and 137, Regent-st, W., London; Plume Works, Aston, Birmingham; and 29, Princes-st, Manchester

BRASS FOUNDERS (*see* Metal Founders).

BRASS PLATE MAKERS AND ENGRAVERS.

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Lansard & Co, 216, Goswell-rd, London, E.C.

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TAYLOR, TUNNICLIFF & CO, Eastwood, Hanley ; and 47, Holborn-viaduct, London, E.C. **See Advt., p. 485**

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at which the Theoretical and Practical Applications of Electricity are a feature of the Curriculum).

*For List of Professors in the Universities and Colleges marked * see pp. 264 to 273, and also entries in Alphabetical Section.*

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Bow and Bromley Institute, Railway Station, Bow-rd, London, E.C.
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*City and Guilds Technical College, Leonard-st, Finsbury, London, E.C.
City of London College, White-st, Moorfields, London, E.C.
City of London Young Men's Christian Association, 185, Aldersgate-st, London, E.C.
*Crystal Palace Company's School of Practical Engineering, Crystal Palace, Sydenham, London, S.E.
*Dublin University
*Durham College of Science, Newcastle-on-Tyne
*Edinburgh University
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*Firth College, Sheffield
*Glasgow and West of Scotland Technical College, Glasgow
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*Rutherford Science College, Newcastle-on-Tyne
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People's Palace Technical Schools, Mile End-rd, London, E.
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*Queen's College, Birmingham
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*Royal College of Science, Dublin
*Royal College of Science, South Kensington, London, S.W.
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SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W.; and Woolwich. **See Advt. inside front cover**

COPPER PLATERS (*see also* Electro-Platers.)

STURTEVANT, T. T., St. John's Works, 92, Clerkenwell-rd, London, E.C. **See Advt., p. 596**

COPPER TAPE MANUFACTURERS.

Baxendale & Co, Miller-st, Manchester; and Edinburgh

COTTON WASTE MERCHANTS.

HATCH, GEORGE, Crown Wharf, 5, Upper Thames-st, London, E.C.

WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

COUNTERS FOR ELECTRICITY METERS.

Berend (O.) & Co, 61, Fore-st, London, E.C. (*Yttrium London*)
Various patterns; also made to order.

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

COUNTRY HOUSE INSTALLATIONS, Contractors for.

Baxendale & Co, Miller-st, Manchester; and Edinburgh

BRITISH ELECTRIC LIGHT COMPANY, THE, Limited, 11, Delahay-st, Westminster, London, S.W. **See Advt., p. 49**

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BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

DAVIS (J.) & SON, All Saints Works, Derby; and 118, Newgate-st, London, E.C.

DRAKE & GORHAM, Victoria-st, London, S.W. **See Advt., p. 15**

Howell, J. C., Limited, 24, Queen Victoria-st, London, E.C., and Llanelly, South Wales

JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C.; and Victoria Works, Charlton, Kent. **See Advt., p. 3**

LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, 64, Millbank-st, S.W., and 11, Abchurch-lane, E.C., London. **See Advt., p. 602**

Lund Bros. & Co, 123 and 125, Oxford-st, London, W.

MACCARTHY, C. C., 23, Corporation-st, and 16, William-st South, Belfast. **See Advt., p. 49**

Moody Brothers, 66, Victoria-st, London, S.W.

Paterson & Cooper, European Works, Pownall-rd, Dalston, N.E., and 68, Victoria-st, S.W., London. **See Advt., p. 39**

ROYCE (F. H.) & CO, Cooke-st, Hulme, Manchester. (*Switch Manchester, Nat. 772*)

Russell & Co, 11, Queen Victoria-st, London, E.C.; and 6, St. Andrew's-st, Cambridge

Sax (Julius) & Co, Limited, 7, Ridgmount-st, Bedford-sq, W.C.: and 366, Central Markets, West Smithfield, E.C., London

Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.

SHERBORNE ELECTRIC INSTALLATION, Sherborne, Dorset

Smiths & Co., Limited, 89, George-st, Edinburgh

TOWNSEND & McINTYRE, 15, Brook-st, W., and 189, Drummond-st, Euston-rd, N.W., London

CRANES AND HOISTS, MAKERS OF.

Appleby Bros., 22, Walbrook, London, E.C.

Bedford Engineering Co, Bedford

Brooke, J. W., Adrian Ironworks, Lowestoft

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, S.E., London

Burton, C. W., 158, Queen Victoria-st, London, E.C.

Carrick & Ritchie, Waverley Engineering Works, Easter-rd, Edinburgh

Cowans, Sheldon & Co, Limited, Carlisle

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

HATCH, GEORGE, Crown Wharf, 5, Upper Thames-st, London, E.C.

Howell, J. C., Limited, 24, Queen Victoria-st London, E.C.; and Llanelly, South Wales
Speciality: Electric Derrick Cranes for Builders.

Isles, Limited, Stamingley.

Jessop (J.) & Son, London Steam Crane and Engine Works, Leicester

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Newbold (Walter) & Co, 1A, Laurence Pountney-hill, London, E.C.

Pickering, Swain & Co, Limited, 5, John Dalton-st, Manchester

PRENTICE, NAPIER, 73, Queen Victoria-st, London, E.C.; and Stowmarket, Suffolk

Russell (Geo.) & Co, Motherwell, near Glasgow

Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.

Selig, Sonnenthal & Co, 85, Queen Victoria-st, and Lambeth-hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7**

SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W.: and Woolwich. **See Advt. inside front cover**

Smith, Thomas, Rodley, near Leeds; and 85, Gracechurch-st, London, E.C.

STATTER (J. G.) & CO, Limited, 68, Victoria-st, S.W., and Cuba-st, Millwall, E. London. (Telegrams: *Statter London*. Telephone No. *3138*.) **See Advt., p. 471**

Tweddell's System, Limited, 14, Delahay-st, Westminster, London, S.W.

Vaughan & Son, West Gorton, Manchester

Wilson (John H.) & Co, Limited, Sandhills, Liverpool; and 6, Delahay-st, London, S.W.

YOUNGS, Ryland-street Works, Birmingham

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Burt, Boulton & Haywood, 64, Cannon-st, London, E.C.; and Prince Regent's Wharf, Silvertown, Essex

Dussek Bros & Co, Verney-rd, Old Kent-rd, London, S.E.

Gabriel (T.) & Sons, Commercial-rd, Lambeth, and Rotherhithe, London, S.E.

Grindley & Co, Upper North-street, Poplar, London, E.

Levin and Rowehl, 12, Chapel-st, Milton-st, London, E.C.

CRUCIBLES, MAKERS OF.

BEREND (O.) & CO., 61, Fore-st, London, E.C.
(*Yttrium London*)
Platinum and Iridio-Platinum Crucibles.

DOULTON & CO., Lambeth Pottery, London, S.E. **See Advt. p. 579**

Morgan Crucible Company, Limited, Battersea, London, S.W.

CUT-OUTS, OR FUSIBLE SAFETY PLATES, MAKERS OF.

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(*Yttrium London*)

BINKO (H.) & CO., 34, Leadenhall-st, London, E.C.

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, Lambeth, S.E., London

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CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advt., pp. 56 and 302, and inside back cover.**

DELAWARE HARD FIBRE COMPANY, Wilmington, Del., U.S.A.; and 15, Long-lane, London, E.C. **See Advt., p. 576**

DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocers' Hall-ct, London, E.C. **See Advt., p. 11**

DRAKE & GORHAM, 66, Victoria-st, London, S.W. **See Advt., p. 15**

Edison & Swan United Electric Light Company Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.

ELECTRICAL COMPANY, Limited, 122, and 124, Charing Cross-rd, London, W.C. **See Advt., p. 539**

EVERED & CO., Limited, 27-31, Drury-lane, W.C.; 143, High-st, Shoreditch, E., and 50, Holborn-viaduct, E.C., London; and Surrey Works, Southwark. **See Advt., p. 38**

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

LAING, WHARTON & DOWN, 82A, New Bond-st, W., and 17, Gracechurch-st, E.C., London; and Guardian-bldg, Manchester. **See Advt., p. 42**

LAURENCE, SCOTT & CO., Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**

Lundberg, A. P., Bradbury Electrical Works, Bradbury-st, Kingsland, London, N. **See Advt., p. 619**

Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

POOLE & WHITE, Limited, 58 and 59, Bread-st, London, E.C. **See Advt., p. 620**

ROYCE (F. H.) & CO., Cooke-st, Hulme, Manchester. (*Switch Manchester, Nat. 772*)

SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt., inside front cover.**

VERITY (B.) & SONS, 31 and 32, King-st, Covent Garden, W.C., and 137, Regent-st, W., London; Plume Works, Aston, Birmingham; and 29, Princes-st, Manchester

Walker (Sydney F.) & Co, Cardiff Electrical Works, Severn-rd, and 33, Castle-st, Cardiff

WOODHOUSE & RAWSON UNITED, Limited, 88, Queen Victoria-st, London, E.C. **See Advt., p. 55**

CUT-OUTS (MAGNETIC), MAKERS OF.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

DRAKE & GORHAM, 66, Victoria-st, London, S.W. **See Advt., p. 15**

EASTON & ANDERSON, Limited, 3, Whitehall-pl, London, S.W.; and Erith, Kent. **See Advt., p. 516**

EDISON & SWAN UNITED ELECTRIC LIGHT COMPANY, Ltd, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., 453, 484, 524, 547, 570 and 572**

ELECTRICAL COMPANY, Limited, 122 and 124, Charing Cross-rd, London, W.C. **See Advt., p. 539**

ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt. on back cover.**

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

PRENTICE, NAPIER, 73, Queen Victoria-st, London, E.C.; and Stowmarket, Suffolk

WOODHOUSE & RAWSON UNITED, Limited, 88, Queen Victoria-st, London, E.C. **See Advt., p. 55**

CYCLE LAMPS, MAKERS OF.

BRISTOL ELECTRIC SAFETY LAMP WORKS, 63, Queen Victoria-st, London, E.C. **See Advt., p. 601**

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Sherborne Electric Installation, Sherborne, Dorset

DIFFERENTIAL VOLTMETERS, MAKERS OF.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)

DIOPTRIC SHADE MAKERS.

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ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**
GILKES' STEAM ENGRAVING WORKS, Reading, Berks. **See Advt. p. 565**
SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon
VINTER, W., 3, Dyer's-bldgs, Holborn, London, E.C.

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GENERAL ELECTRIC COMPANY, Limited 69 and 71, Queen, Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester **See Advt., p. 486**
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Sherborne Electric Installation, Sherborne, Dorset

DRILLING MACHINES, MAKERS OF.

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HATCH, GEORGE, Crown Wharf, 5, Upper Thames-st, London, E.C.
Ingersoll—Wellington & Co., 100c, Queen Victoria-st, London, E.C.
Newbold (Walter) & Co, 1A, Laurence Pountney-hill, London, E.C.
SELIG, SONNENTHAL & CO., 85, Queen Victoria-st, and Lambeth-hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7**
SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail Croydon, and Cromwell Iron Works, Croydon
Square Drilling Machine Company, Limited, 23, Budge-row, Cannon-st, London, E.C.
THAMES IRON WORKS & SHIPBUILDING COMPANY, Limited, Orchard-yard, Blackwall, London, E. **See Advt. inside back cover**
WILLCOX (W. H.) & CO., 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt. p. 1**

DRIVING BAND MAKERS.

Cotton.

Aitken (Thos.) & Son, Helmshore, Manchester
Armitage (Sir Elkanah) & Sons, Limited, 48 Mosley-st, Manchester; and at London
BAGSHAWE BROS. & CO, 4A, Upper Thames-st, London, E.C. **See Advts., pp. 606 and 617**
Cobbett, W. W., 82, Southwark-st, London, S.E.
FLEMING, BIRKBY & GOODALL, Limited, West Grove Mill, Halifax. **See Advts. below and p. 616**
Kenyon (William) & Sons, Dukinfield, Cheshire.
MOSELEY (DAVID) & SONS, Chapel Field Works, Ardwick, Manchester; and at London and Glasgow. **See Advt., p. 56**
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

Hair.

MOSELEY (DAVID) & SONS, Chapel Field Works, Ardwick, Manchester; and at London and Glasgow. **See Advt., p. 56**
TURNER BROS, Spotland, Rochdale.
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

India Rubber.

Ancoats Vale Rubber Company, Limited, 11, Bow-lane, London, E.C.; and Manchester
Anderson, Anderson & Anderson, Limited, 37, Queen Victoria-st, and 35, St. Paul's Churchyard, London, E.C.; and Bristol and Cardiff
Jones & Bradshaw, 13A. Eastcheap, London, E.C.
MOSELEY (DAVID) & SONS, Chapel Field Works, Ardwick, Manchester; and at London and Glasgow. **See Advt., p. 56**
Tasker, Sons & Co, 32, Angel-st, and New Station-rd, Sheffield
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

Leather.

Ashton (John) & Son, 36, Withy-grove, Manchester; and Hyde-rd, Gorton
Ashworth, A. & H. H., Grove Works, Ashworth-st, Bury New-rd, Higher Broughton, Manchester
BAGSHAWE BROS. & CO, 4A, Upper Thames-st, London, E.C. **See Advts., pp. 606 and 617**
Balderston & Co, 201, St. Vincent-st, Glasgow
Churchill (Charles) & Co, Limited, 21, Cross-st, Finsbury, London, E.C.; and 6, Albert-st, Birmingham

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Cooke, E. J., Parsonage, Manchester
FLEMING, BIRKBY & GOODALL, Limited, West Grove Mill, Halifax. **See Advts. on previous page and on p. 616**
Gandy Belt Manufacturing Company, Limited, Wheatland Works, Seacombe, Cheshire; and 130, Queen Victoria-st, London, E.C.
HATCH, GEORGE, Crown Wharf, 5, Upper Thames-st, London, E.C.
Hepburn & Gale, Limited, 239, Long-lane, Southwark, London, S.E.
Irwell Rubber Co., 41, St. Mary-axe, London, E.C., and at Salford
Laycock (W.) & Sons, Queen-street Leather Works, Keighley
Mapplebeck, Howard & Co, 12 and 14, Bath-row Holloway Head, Birmingham
Mason (D.) & Sons, 12 and 14, Bath-row, Holloway Head, Birmingham
McIntosh (Peter) & Sons, 129, Stockwell-st, Glasgow
MOSELEY (DAVID) & SONS, Chapel Field Works, Ardwick, Manchester; and at London and Glasgow. **See Advt., p. 56**
NAYLER, JOHN, 200, High-st, Dudley
Norris (S. E.) & Co, 56-58, High-st, Shadwell, London, E., and 62, St. Vincent-st, Glasgow
Ormerod (J.) & Sons, Castleton, near Manchester
Prellers Leather Company (Stevens, Pellatt & Co), 57, Lant-st, Southwark, London, S.E.
RAWLINGS (S.) & SON, South Parade Works, Frome; and 9, Gracechurch-st, London, E.C.
Rossendale Belting Company, 10, West Mosley-st, Manchester; and at Glasgow; and London

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Walton (John) & Sons, 36, Charlotte-lane, Glasgow
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

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WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

DRIVING BAND STAPLERS AND STAPLES, MAKERS OF.

WILLCOX (W. H.) & CO, 34 and 36 Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

DRIVING CHAIN MAKERS.

BAGSHAWE BROS & CO, 4A, Upper Thames-st, London, E.C. **See Advts., pp. 606 and 617**

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THOMSON (ARCHIBALD) & CO, 58, Howard-st, Glasgow
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

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Auto Machinery Co, Limited, Read-st, Coventry
BARTON, THOMAS, Electric Works, Blackburn (*Barton Blackburn, 265*)
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"Tempered" Copper Dynamo Brushes.
Boudreaux Dynamo Brush Co, St. Martin's House, 1, Gresham-st, London, E.C.
Carbone, Le (late Lacombe & Co), 7, Carteret-st, Westminster, London, S.W.
CHRISTIE, GEORGE, Limited, Ladywell Wire Works, Glasgow. **See Advt., p. 643**
DICKSON, JAMES, 48, Gray's Inn-rd, London, W.C. **See Advt. on next page**
Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**
ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chambers, Queen-st, London, E.C.; and Wolverhampton

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LAING, WHARTON & DOWN, 82A, New Bond-st, W., and 17, Gracechurch-st, E.C., London; and 32A, Tower-bldgs, Water-st, Liverpool. **See Advt., p. 42**
MacCARTHY, C. C., Belfast Electrical Works, 23, Corporation-sq, and 16, William-st South, Belfast. **See Advt., p. 49**
MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chmbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**
NORTH BRITISH WIRE MANUFACTURING COMPANY, 130, Fleet-st., London, E.C., and 71, West Nile-st, Glasgow. **See Advt. on previous page**
Paterson & Cooper, European Works, Pownall-rd, Dalston, N.E., and 68, Victoria-st, S.W., London. **See Advt., p. 39**
Patterson, William, City Wire Works, 5, Carlisle-sq, Newcastle-upon-Tyne
Pratt, A. H., 37, Devonshire-st, Bloomsbury, London, W.C.
RIDDELL, (WM.) & CO, 636, Springfield-rd, Glasgow
ROYCE (F. H.) & CO, Cooke-st, Hulme, Manchester. (*Switch Manchester, Nat. 7720*)
Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.
Sherborne Electric Installation, Sherborne, Dorset
SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London S.W.; and Woolwich. **See Advt. inside front cover**
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Sole Makers of the Patent IMPERIAL *Dynamo Magnet Steel Castings.*
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BARTON, THOMAS, Electric Works, Blackburn. (*Barton Blackburn, 2657*)
Boden, H. O., 1, Walmer-place, Old Trafford, Manchester
Clark, R., Cheapside, Spennymoor
Crofts, Alfred, 7, Water-st, Deal
Electrical Accessories Company, Ltd., 110, Charing Cross-rd, London, W.C.
ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chambers, Queen-st, London, E.C.; and Wolverhampton
Falkirk Iron Company (R. W. Kennard & Co), 67, Upper Thames-st, London, E.C.; and Liverpool, Glasgow, and Edinburgh. Works: Falkirk, N.B.
Hadfield's Steel Foundry Company, Hecla Works, Sheffield; and 156 and 157, Leadenhall-st, London, E.C.
Jenkins, R., 88, Bishopsgate-st, London, E.C.
Martin & Co, 75, East-rd, West Ham, London, E.
Richards (J. H.) & Co, Corporation-st, Manchester
Roy, A. W., 67, Ryker-hill, Newcastle-upon-Tyne
Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.
Turner Bros, 134, Upper Thames-st, London, E.C.

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"Tempered" Copper Dynamo Segments.
ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chambers, Queen-st, London, E.C.; and Wolverhampton

DYNAMO OIL MANUFACTURERS.

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DYNAMOS, MAKERS OF (*see also* Motors, Electric).

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Coventry — Coventry Electrical Engineering Company, Volt Works, Craven-street, Coventry

Deal—Crofts, Alfred, 7, Water-st, Deal

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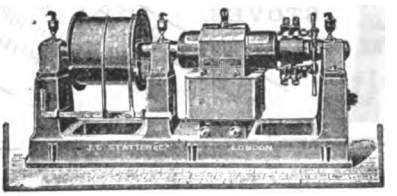

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St. John, L. A., 2, Prospect-pl, Leytonstone, London, E.
Sax (Julius) & Co, Limited, 7, Ridgmount-st, Bedford-sq, W.C., and 366, Central Markets, West Smithfield, E.C., London
Scadding & Son, Magdalen-st, Exeter
Shaw (W. A.) & Co, 6, Warren-st, Stockport
Sherborne Electric Installation, Sherborne, Dorset
Shirras (Wm.) & Son, 44, School Hill, Aberdeen
SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**
Smith (Archibald) & Stevens, Janus Works, Queen's-rd, Battersea, London, S.W.
Smith, C. J., 23, King-st, Golden-square, London, W.
Smith, T. B., 20 & 22, Queen-st, Watford
STEGMANN, GEORGE, 69, St. John's-hill, Clapham Junction, London, S.W.
Stewart (T.) & Sons, Cross, Kilmarnock
Sutton, William, Wollaton-st, Nottingham
Swain, Geo., 194, Plumb-lane, Bradford
Taylor (J.) & Co, Loughborough
Usher (Thos. G.) & Co, Norfolk-st, Sunderland; and Eldon-lane W., Newcastle-on-Tyne
Wadsworth, Russell, 27, Ebury-st, London, S.W.
Wagner, C. T., 206 and 207, Upper Thames-st, London, E.C.
Walker (Sydney F.) & Co, Cardiff Electrical Works, Severn-rd, and 33, Castle-st, Cardiff

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Walters (Philip) & Co, 249 & 251, Kensal-rd, and Conlan-st, London, W.
Watson (Henry) & Sons, High Bridge Works, Walker's Gate, Newcastle-on-Tyne
Weller, G., 60, Newington-causeway, London, S.E.
White & Sons, 207, Oxford-st, London, W.
Wild, Dagger & Co, 6B, The Temple, Dale-st, Liverpool
Wilson & Son, 7, 8 & 9, King William-street, Strand, W.C., and 7, Rose-st, Soho, W., London
Wilson & M'Lellan, 104, Renfrew-st, Glasgow
WRIGHT, ARCHIBALD J., 52, Cromwell-avenue, Highgate, London, N.
Young & Buss, 18, Blandford-st, W., and 15, Hill-st, N.W., London
Zimdars, C. E., 327, Gray's Inn-rd, London, W.C.

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BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
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Corlett Electrical Engineering Company, Limited, Rowbottom-sq, Wigan; and Breightmet-st, Bolton
CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**
DAVIS (J.) & SON, All Saints Works, Derby; and 118, Newgate-st, London, E.C.
Electric Blasting Apparatus Company, Cinderford, Gloucestershire
GOOLDEN (W. T.) & CO, Woodfield Works, Harrow-rd, London, W.
Ingersoll-Sergeant Drill Company, 114A, Queen Victoria st, London, E.C.
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Watson, J. R., 35, Queen Victoria-st, London, E.C.
WOODHOUSE & RAWSON UNITED, Limited, 88, Queen Victoria-st, London, E.C. **See Advt. p. 55**

ELECTRIC BURGLAR ALARMS, MAKERS OF.

Baxendale & Co, Miller-st, Manchester; and Edinburgh
BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.
Croggon & Co, Limited, 16, Upper Thames-st, London, E.C; 19, Tithebarn-st, Liverpool; and 7, John-st, Glasgow
Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**
GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; Glasgow, Birmingham and Manchester. **See Advt., p. 486**
Kingsland, William, 17, Avenue-rd, St. John's Wood, London, N.W.; and Clarence-bldgs., Gloddaeth-st, Llandudno
Lansard & Co, 216, Goswell-road, London, E.C.
MANCHESTER EDISON-SWAN COMPANY, Limited, 29, Temple-chmbrs, Brazennose-st, Manchester. **See Advt., p. 10**
Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.
ROYCE (F. H.) & CO, Cooke-st, Hulme, Manchester. (*Switch Manchester, Nat. 772*)
Sax (Julius) & Co, Limited, 7, Ridgmount-st, Bedford-sq, W.C.; and 366, Central Markets, West Smithfield, E.C., London
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ELECTRIC CABLE MACHINERY, MAKERS OF.

CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**
Clarke, T. A. W., Havelock Works, Leicester
Dean, T., East Surrey Foundry, Pitlake, Croydon
GLOVER (W. T.) & CO, Salford, Manchester; and Albany-bldgs, 39, Victoria-st, London, S.W. **See Advt., p. 40**
James, H., 20 and 21, Windley's Factory, Rodenst, Nottingham
JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, E.C., and Victoria Works, Charlton, S.E., London. **See Advt., p. 3**
SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**
TELEGRAPH CONSTRUCTION and MAINTENANCE COMPANY, Limited, 38, Old Broad-st, E.C.; Morden and Enderby's Wharves, Greenwich, S.E.; and Wharf-rd, City-rd, London, N.

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(*See also* **Anti-Induction Cables, Telegraph Cables** *and* **Wire, Telephone Wires, &c.**)

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CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**
CONNOLLY BROS, Blackley, Manchester. (*Connollys Blackley, 2361*). **See Advt. on next page**
CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

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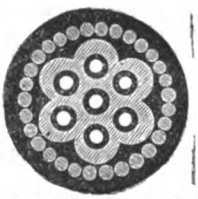

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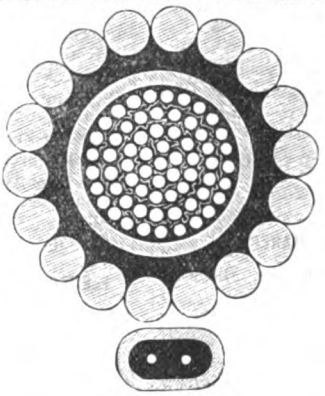

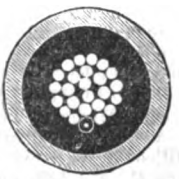

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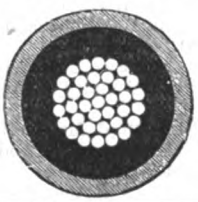

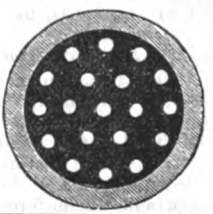

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Edison & Swan United Electric Light Company; Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

FOWLER-WARING CABLES COMPANY, Limited, 4, Victoria-mansions, Victoria-st, London, S.W. (Waring Anti-Induction Cables.) **See Advts., pp. 302 and 475**

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

GLOVER (W. T.) & CO, Salford, Manchester; and Albany-bldgs, 39, Victoria-st, London, S.W. **See Advt., p. 40**

Henley's (W. T.) Telegraph Works Company, Limited, 27, Martin's-lane, Cannon-st, London, E.C. Works: North Woolwich

Hooper's Telegraph and India Rubber Works, 31, Lombard-st, London, E.C.

India Rubber Gutta Percha and Telegraph Works, Company, Limited, 106, Cannon-st, London, E.C.; and Silvertown, Essex

JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C., and Charlton, Kent. **See Advt., p. 3**

LAING, WHARTON & DOWN, 82A, New Bond-st, W., and 17, Gracechurch-st, E.C., London; and Guardian-bldgs, Manchester. **See Advt., p. 42**

LONDON ELECTRIC WIRE COMPANY, Limited, Anchor Works, Playhouse-yd, Golden-lane, London, E.C. **See Advt., p. 12**

Northern Electric Wire Company, Halifax (*Cables Halifax, 127*)

Okonite Company, Limited, 38, Finsbury-pavement, London, E.C.

RAMSDEN, CAMM & CO, Brighouse, Yorkshire. **See Advt., p. 10**

REID BROS, 12, Wharf-rd, City-rd, London, N. **See Advt., p. 14**

Rickard, William, Ashbourne-rd Mills, Derby

SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 38, Old Broad-st, E.C.; Morden and Enderby's Wharves, Greenwich, S.E.; and Wharf-rd, City-rd, London, N.

Telegraph Manufacturing Company, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.

ELECTRIC CALL INSTRUMENTS, MAKERS AND ERECTORS OF.

GENERAL ELECTRIC COMPANY, Limited, 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

Keighley Electrical Engineering Company, Limited, Bow-st, Keighley, Yorks.

Sax (Julius) & Co, Limited, 7, Ridgmount-st, Bedford-sq, W.C.; and 366, Central Markets, West Smithfield, E.C., London

ELECTRIC CLOCKS, MAKERS OF.

ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518.**

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C., and at Glasgow, Birmingham and Manchester. **See Advt. p 486**

GLOVER (W. T.) & CO, Salford, Manchester; and 39, Victoria-st, London, S.W. **See Advt., p. 40**

Hannan & Buchanan, 75, Robertson-lane, Glasgow

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

Standard Time Company, Limited, 19 and 21, Queen Victoria-st, London, E.C.

ELECTRIC COAL-CUTTERS, MAKERS OF.

CLARKE, CHAPMAN & CO, Limited, Victoria Works, Gateshead-on-Tyne. **See Advt., p. 46**

DAVIS (J.) & SON, All Saints Works, Derby; and 118, Newgate-st, London, E.C.

Electric Coal-Cutting Contract Corporation, Limited, 2, St. Nicholas-bldgs, Newcastle-on-Tyne

ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st, London, E.C.; and Wolverhampton.

Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.

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CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and Showrooms with apparatus in operation at 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See coloured inset facing pp. 478 and 479**

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

ELECTRIC CRANES AND HOISTS, MAKERS OF.

Bolton Engineering Co, Turton-st, Bolton, Lancs.

Broadbent (T.) and Sons, Central Iron Works, Huddersfield

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, Lambeth, S.E., London

CARRICK & RITCHIE, Waverley Engineering Works, Easter-rd, Edinburgh

CLARKE, CHAPMAN & CO, Limited, Victoria Works, Gateshead-on-Tyne. **See Advt., p. 46**

Clark, Joseph, Laisterdyke, near Bradford

Craven Bros, Ltd, Vauxhall Iron Works, Manchester

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CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

GOOLDEN (W. T.) & CO, Woodfield Works, Harrow-rd, London, W.

Howell, J. C., Limited, 24, Queen Victoria-st, London, E.C.; and Llanelly, South Wales
Speciality: Electric Derrick Cranes for Builders.

MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. (*Mather Manchester; Bath-metal London*)

Otis Elevator Company, Limited, 4, Queen Victoria-st, London, E.C.; and at Glasgow

Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.

SMITH, THOMAS, Rodley, near Leeds

STATTER (J. G.) & CO, Limited, 68, Victoria-st, S.W., and Millbank, E., London. (Telegrams: *Statter London.* Telephone *No. 3158*) **See Advt., p. 471**

STOTHERT & PITT, Limited, Bath; and 30, Walbrook, London, E.C.

THAMES IRON WORKS & SHIPBUILDING COMPANY, Limited, Orchard-yard, Blackwall, London, E. **See Advt. inside back cover**

Thomas (Thos.) & Sons, Acme Hoist Works, Cardiff; and Queen Victoria-st, London, E.C.

Vaughan & Sons, West Gorton, Manchester

Waygood (R.) & Co, Falmouth-rd, Great Dover-st, London, S.E.

Wimshurst, Hollick & Co, 602, Commercial-rd East, London, E.

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Electrical Accessories Company, Limited, 10, Charing Cross-rd, London, W.C.

MANCHESTER EDISON-SWAN COMPANY, Limited, Temple Chambers, 29, Brazennose-st, Manchester. **See Advt., p. 10**

ROUTLEDGE, WILLIAM, 46, Low Friar-st, Newcastle-upon-Tyne

Schall, K., 55, Wigmore-st, London, W.

ELECTRIC DOOR OPENERS, MAKERS OF.

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

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THAMES IRON WORKS & SHIPBUILDING COMPANY, Limited, Orchard-yard, Blackwall, London, E. (Rowan's Patent) **See Advt. inside back cover**

ELECTRIC FIRE ALARMS, MAKERS OF.

(*See also* **Electrical Apparatus Makers.**)

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Croggon & Co, Limited, 16, Upper Thames-st, London, E.C.; 19, Tithebarn-st, Liverpool; and 7, John-st, Glasgow

Emerson (F. E.) & Co, 46, Maplin-st, Mile End-rd, London, E.

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow Birmingham, and Manchester. **See Advt., p. 486**

Harris, W. J., 91, Shadwell-st, Birmingham

JAMES, HENRY, J., 135, Cowick-st, St. Thomas, and 63, Bonhay-rd, Exeter

Keighley Electrical Engineering Company, Limited, Bow-st, Keighley, Yorks

Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

RETTIE, CHARLES, 18, Geraint-st, Liverpool

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Andrews (J. D. F.) & Co, 15, Marsham-st, Westminster, London, S.W.

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CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advt., pp. 56 and 302, and inside back cover**

DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocer's Hall-court, Poultry, London, E.C. **See Advt., p. 11**

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

Electric Blasting Apparatus Company, Cinderford, Gloucestershire

ELECTRICAL COMPANY, Limited, 122, and 124, Charing Cross-rd, London, W.C. **See Advt., p. 539**

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham, and Manchester. **See Advt., p. 486**

GLOVER (W. T.) & CO, Salford, Manchester; and Albany-bldgs, 39, Victoria-st, London, S.W. **See Advt., p. 40**

Nobel's Explosives Company, Limited, 220, Winchester House, Old Broad-st, London, E.C.; and at Glasgow

Roburite Explosive Company, Limited, 103, Cannon-st, London, E.C.; and Gathurst, near Wigan

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Baxendale & Co, Miller-st, Manchester; and Edinburgh

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and Glasgow, Birmingham, and Manchester. **See Advt., p. 486**

Haseler (Charles) & Son, 94, Bridge-st West, Birmingham

MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chmbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**

SHERBORNE ELECTRIC INSTALLATION, Sherborne, Dorset

WOODHOUSE & RAWSON UNITED, Limited, 88, Queen Victoria-st, London, E.C. **See Advt., p. 55**

ELECTRIC GOVERNORS AND REGULATORS, MAKERS OF.

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st., E.C., and 112, Belvedere-rd, Lambeth, S.E., London

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

Selig, Sonnenthal & Co., 85, Queen Victoria-st, and Lambeth Hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7**

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ELECTRIC HAND LAMPS, MAKERS OF.

(*See also* **Portable Electric Lamps.**)

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

BRISTOL ELECTRIC SAFETY LAMP WORKS, 63, Queen Victoria-st, London, E.C. **See Advt., p. 601**

BRITISH ELECTRIC LIGHT COMPANY, THE, Limited, 11, Delahay-st, Westminster, London, S.W. **See Advt., p. 49**

Cathcart, Peto & Radford, 57B, Hatton-gdn., London, E.C.

DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocer's Hall-court, Poultry, London, E.C. **See Advt., p. 11**

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.

LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, 64, Millbank-st, S.W., and 11, Abchurch-lane, E.C., London. **See Advt., p. 602**

MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chmbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**

PITKIN, JAMES, 56, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 491**

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GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria st, London, E.C.; and at Glasgow, Birmingham and Manchester **See Advt., p. 486**

ELECTRIC HOUSE WORK, CONTRACTORS FOR.

Adamson, D. F., Moorgate-chambers, 72, Finsbury-pavement, London, E.C.

Baxendale & Co, Miller-st, Manchester, and Edinburgh

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

BLACKBURN, R. S., 2, Hollins-cres, and Hangingroyd-lane, Hebden Bridge, Yorks.

BRITISH ELECTRIC LIGHT COMPANY, THE, Limited, 11, Delahay-st, Westminster, London, S.W. **See Advt., p. 49**

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C.; and 112, Belvedere-rd, S.E., London.

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CROMPTON & CO., Ltd.,

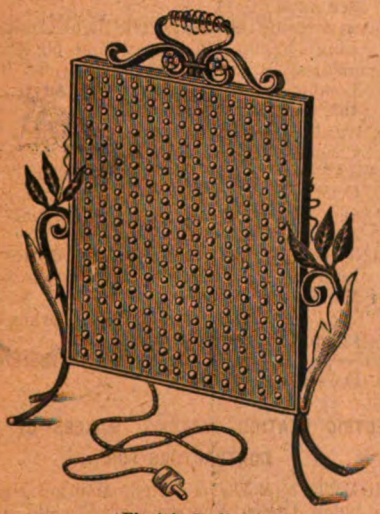
148, BROMPTON ROAD, LONDON, S.W.

ELECTRICAL HEATING AND COOKING APPARATUS.

NO COMBUSTION. NO SMELL. NO DANGER.
NO FIRE. NO EXPLOSION.

Utensils always Clean.
Food cooked in perfectly Pure Atmosphere.

The Cost of Cooking by Electricity (owing to reduced charges for current made by Supply Companies) is in many cases Less than Gas.

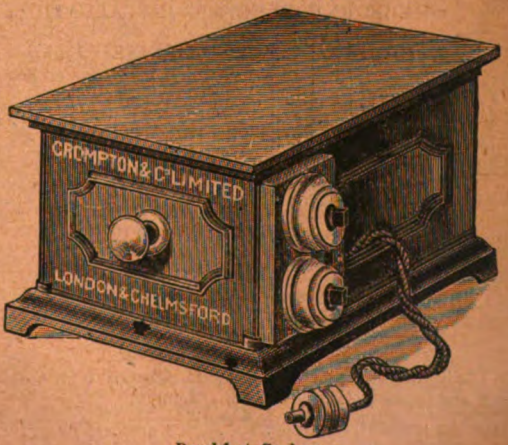


Electric Radiator.

Electric Kettle

Electric Flat Iron.

Electric Heater on Hammered Iron Stand, With Copper Kettle.



Breakfast Cooker.

CATALOGUES AND TERMS TO THE TRADE FREE ON APPLICATION.

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[Face page

CROMPTON & CO.

LIMITED,

SHOW ROOMS

148, BROMPTON RD., LONDON, S.W.

MANUFACTURERS OF

ELECTRICAL COOKING AND HEATING APPARATUS.

(CROMPTON AND DOWSING'S PATENTS).

The ELECTRIC OVEN is the Most Perfect Cooking Apparatus made.

DIPLOMA, GOLD MEDAL, AND HIGHEST AWARDS, LONDON, 1893.

No Fire. — Absolutely Safe.

No Smoke. — Absolutely Pure.

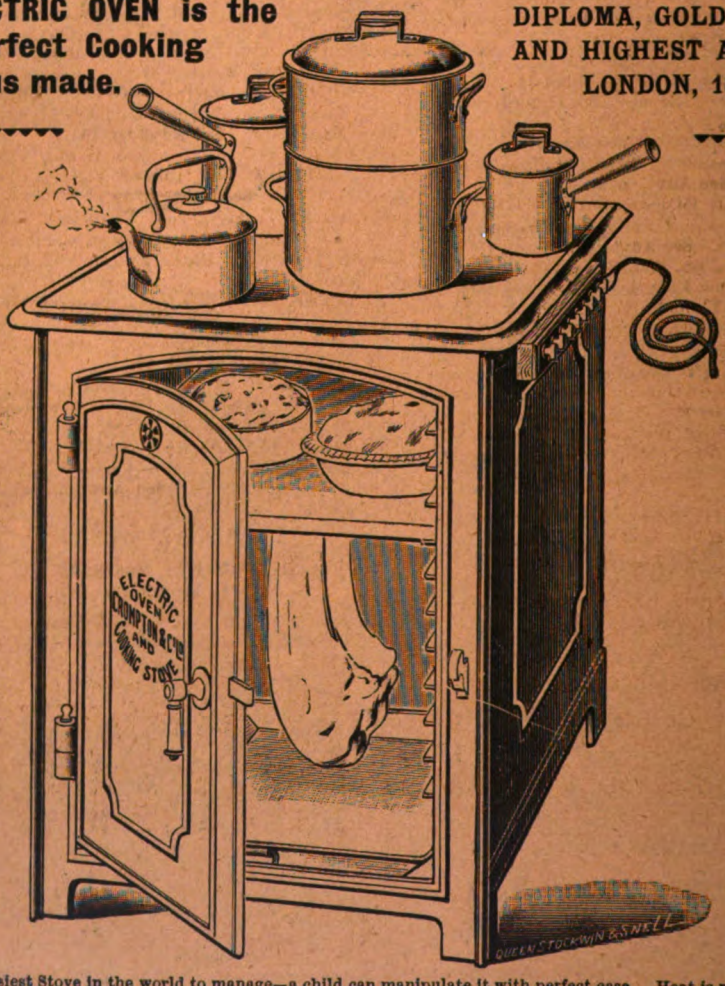
No Smell. — Absolutely Clean.

No Combustion. — Absolutely Free from Danger.

No Foul Gases. — Absolutely Best System of Cooking.

No Chimney. — Absolutely Free from Burning.

No Explosion. — Absolutely Perfect.



It is the easiest Stove in the world to manage—a child can manipulate it with perfect ease. Heat is radiated **from all sides** and top and bottom. It can be turned off and on at pleasure. The Oven will cook for a considerable time after the current is turned off. *PRICES AND ALL PARTICULARS ON APPLICATION.*

NOTE.—Electric Supply Companies are now purchasing these Ovens to let out to their Customers.

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CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

DAVIS (J.) & SON, All Saints Works, Derby; and 118, Newgate-st, London, E.C.

ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chbrs., Queen-st, London, E.C.; and Wolverhampton

Electric Fittings Hiring and Maintenance Company, Limited, 21, Lime-st, London, E.C.

Electric Wiring and Fittings Company, Limited, 2, Princes-st, Great George-st, London, S.W.; and 23, Market-st, Nottingham

Fuller & Tate, 20, Bucklersbury, London, E.C.

HEMINGWAY, C. A., 10, Petersham-rd, Richmond, Surrey

LAING, WHARTON & DOWN, 82A, New Bond-st, W., and 17, Gracechurch-st, E.C., London; and Guardian-bldng, Manchester. **See Advt., p. 42**

Long, Thomas (late Liddiard & Wordley, Limited), 6 and 7, Bank-bldgs, Hastings

Lund Bros. & Co, 123 and 125, Oxford-st, London, W.

MACCARTHY, C. C., Belfast Electrical Works, 23, Corporation-sq, and 16, William-st East, Belfast. **See Advt., p. 49**

MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chmbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**

Moody Brothers, 66, Victoria-st, London, S.W.

Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

OPPERMANN, CARL, 2, Wynyatt-st, Clerkenwell, London, E.C.

OSLER, F. & C., 230, Broad-st, Birmingham; and 100, Oxford-st, London, W.C.

PYKE, HARRIS & CO, Limited, 33 and 34, New Tothill-st, Westminster, London, S.W.

RAWLINGS BROS, 82, Gloucester-road, and Lenthall Works, South Kensington, London, S.W.

Russell & Co, 11, Queen Victoria-st, London, E.C.; and 6, St. Andrews-st, Cambridge

Sax (Julius) & Co., Limited, 7, Ridgmount-st, Bedford-sq, W.C.; and 366, Central Markets, West Smithfield, E.C., London

STEGMANN, GEORGE, 69, St. John's-hill, Clapham Junction, London, S.W.

SWINBURNE & CO, Limited, Broom Hall Works, Teddington. **See Advt., p. 637**

Tayler Smith Electric Company, Limited, 53, South Molton-st, London, W

Usher (Thos. G.) & Co, 34, Norfolk-st, Sunderland; and Eldon-la W., Newcastle-on-Tyne

Wild, Dagger, & Co., 6B, The Temple, Dale-st., Liverpool

Wood, S. P., 10, Paragon-st, Hull

ELECTRIC LAMP MAKERS.

(*See also* **Arc** *and* **Incandescent Lamp Makers.**)

Clark & Co, 417, Brixton-rd, London, S.W.

Humber Lamp Co., Ltd, Great Grimsby

MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chbrs, 29, Brazennose-st, Manchester, **See Advt., p. 10**

Sherman (Stephen) & Son, 26-28, New Compton-st, 171, Shaftesbury avenue, and 5, Bucknall-st, London, W.C.

ELECTRIC LAUNCH, &c., BUILDERS.

Bowen, Kerbey, Limited, 55, Regent-st, London, W., and Ray Mead Works, Maidenhead

Bowles, E. Wingfield, 28, Victoria-st, London, S.W.

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover.**

DRAKE & GORHAM, 66, Victoria-st, London, S.W. **See Advt., p. 15**

Edwards & Symes, Millwall, London, E.

ELECTRIC CONSTRUCTION COMPANY Limited, Queen-street-chbrs, Queen-st, London, E.C.; and Wolverhampton

Fellows (H.) & Son, Great Yarmouth

GOOLDEN (W.) & CO, Woodfield Works, Harrow-rd, London, W.

MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chmbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**

Paterson & Cooper, European Works, Pownall rd, Dalston, N.E., and 68, Victoria-st, S.W., London. **See Advt., p. 39**

Russell & Co, 11, Queen Victoria-st, London, E.C.; and 6, St. Andrews-st, Cambridge

Seath (T. B.) & Co, Rutherglen, and 42, Broomielaw, Glasgow

STATTER (J. G.) & CO, Limited, 68, Victoria-st, S.W., and Millwall, E., London. (Telegrams: *Statter London.* Telephone No. *3138*) **See Advt., p. 471**

Thames Electric and Steam Launch Company, Strand-on-the-green, Chiswick; and Eel Pie Island, Twickenham, Middlesex

THAMES IRON WORKS & SHIPBUILDING COMPANY, Limited, Orchard-yd, Blackwall, London, E. **See Advt. inside back cover**

Yarrow & Co, Isle of Dogs, Poplar, London, E.

ELECTRIC LIFTS, MAKERS OF.

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, Lambeth, S.E., London

MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. (*Mather Manchester; Bath-metal London*)

Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.

SIEMENS BROS. & CO, Ltd, 12, Queen Ann's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover.**

Smith, Thomas, Rodley, near Leeds

ELECTRIC LIGHT APPARATUS, MAKERS OF.

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

Bond (John) & Son, 44, Orchard-pl, Blackwall, London, E.

Breeden (Joseph) & Co., Limited, New Mill Works, Fazeley-st, Birmingham

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BRITISH ELECTRIC LIGHT COMPANY, THE, Limited, 11, Delahay-st., Westminster, London, S.W. **See Advt., p. 49**

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, Lambeth, S.E., London

Christie, J. C., 3 and 5, Mansell-st, Aldgate, London, E.C.

CORLETT ELECTRICAL ENGINEERING COMPANY, Limited, Rowbottom-sq, Wigan; and Breightmet-st, Bolton.

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

Defries (J.) & Sons, Limited, 147, Houndsditch, London, E.C.

DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocer's Hall-court, Poultry, London, E.C. **See Advt., p. 11**

DRAKE & GORHAM, 66, Victoria-st, London, S.W. **See Advt., p. 15**

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.

ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt. on back cover**

EVERED & CO, Limited, 27-31, Drury-lane, W.C., 143, High-st, Shoreditch, E., and 50, Holborn-viaduct, E.C., London; and Surrey Works, Smethwick. **See Advt., p. 38**

FERRANTI (S. Z. DE), Limited, St. Benét-chambers, Fenchurch-st., and 27, Charterhouse-sq, London, E.C. **See Advt., p. 594**

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham, and Manchester. **See Advt., p. 486**

Gent & Co, Faraday Works, Leicester; 3, Maiden-lane, Queen-st, London, E.C.; 47, High Bridge, Newcastle-on-Tyne; 27, Oswald-st, Glasgow; and at Cardiff and Belfast

HOLMES (J. H.) & Co, Portland-rd, Newcastle-upon-Tyne; and 17, Coleman-st, London, E.C.

JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C., and Victoria Works, Charlton, Kent. **See Advt., p. 3**

LAING, WHARTON & DOWN, 82A, New Bond-st, W., and 17, Gracechurch-st, E.C., London; and Guardian-bldg, Manchester. **See Advt., p. 42**

LAURENCE SCOTT & CO, Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**

LITHANODE & GENERAL ELECTRIC COMPANY, Limited, 64, Millbank-st, S.W., and 11, Abchurch-lane, E.C., London. **See Advt., p. 602**

LUNDBERG, A. P., Bradbury Electrical Works, Bradbury-st, Kingsland, London, N. **See Advt., p. 619**

MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. (*Mather Manchester; Bath-metal London*)

Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

NALDER BROS & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 499**

NALDER & HARRISON, Trafalgar House, Great Newport-st, Charing Cross-rd, London, W.C. **See Advt., p. 523**

Nicholls (T.) & Son, 258, Kingsland-rd, London, N.

OSLER, F. & C., 230, Broad-st, Birmingham; and 100, Oxford-st, London, W.C.

PATERSON & COOPER, European Works, Pownall-rd, Dalston, N.E., and 3, Princes-mansions, Victoria-st, S.W., London. **See Advt., p. 39**

PERRY & CO, 17, Grafton-st, Bond-st, London, W. **See Advts., pp. 445, 483, 547 and 598**

POOLE & WHITE, Limited, 58 and 59, Bread-st, London, E.C. **See Advt., p. 620**

PYKE, HARRIS & CO, Limited, 33 and 34, New Tothill-st, Westminster, London, S.W.

Richardson, Ellson & Co, 17 and 18, Brownlow-st, High Holborn, London, W.C.

SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**

SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.

Stewart (D.) & Co, Limited, London-rd Iron Works, Glasgow; and 122, Cannon-st, London, E.C.

VERITY (B.) & SONS, 31 and 32, King-st, Covent Garden, W.C., and 137, Regent-st, W., London; Plume Works, Aston, Birmingham; and 29, Princes-st, Manchester

Waltham Electrical Engineering Company, Chapel-place Works, Great Chapel-st, Westminster, London, S.W. (*Switchboard London*)

WESTINGHOUSE ELECTRIC COMPANY, Limited, 32, Victoria-street, London, S.W. **See Advt., p. 487**

ELECTRIC LIGHT, CONTRACTORS FOR THE SUPPLY OF.

(*See also* **Electricity Supply Companies.**)

Allen & Mannoch, 128, Mount-st, 11, Farm-st, and 1A, Davies-mews, Berkeley-sq, London, W.

Anderson, Joseph, Carnoustie, near Dundee

Anderson & Munro, 136, Bothwell-st, Glasgow

Ardley (A.) & Son, 48, Cannon-st, and 1, Wood-st, London, E.C.

Ash's Stores, Bournemouth

Aurora Electric Lighting and Distribution Company, Ltd, 54, New Broad-st, London, E.C.

Azores Gas and Electric Light Corporation, Limited, 62, King William-st, London, E.C.

BARTON, THOMAS, Electric Works, Blackburn. (*Barton Blackburn, 265*)

Bentley & Co, 17, Newton-st, Piccadilly, and 27, Bootle-st, Deansgate, Manchester

Bertram & Co, 101, Dean-st, Soho, London, W.

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

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PHŒNIX FIRE OFFICE,

19, Lombard Street, and 57, Charing Cross, London.

ESTABLISHED 1782.

Lowest Current Rates. Liberal and Prompt Settlement.
Assured free of all Liability. Electric Lighting Rules supplied.

LOSSES PAID, OVER £19,000,000.

BLACKBURN, R. S., 2, Hollins-cres, and Hangingroyd-lane, Hebden Bridge, Yorks

Blockley Electric Lighting and Manufacturing Company, Limited, Astral Works, Blockley, Worcestershire

Bourne & Grant Electricity Supply Company, Limited, 15, George-st, Mansion House, London, E.C.

BRITISH ELECTRIC LIGHT COMPANY, THE, Limited, 11, Delahay-st, London, S.W. **See Advt., p. 49**

Buckley, J. M., 10, Mortimer-st, and Nassau-st, W., London

Burnby (S.) & Son, 121, Coldharbour-lane, Denmark-hill, London, S.E.

Chamberlain & Hookham, Limited, 4, New Bartholomew-st, Birmingham

Charleton (R. J.) & Co, 131, Pilgrim-st, Newcastle-on-Tyne ; and at Scarborough

Cheeld, Sydney, Chesham, Bucks.

City of London Contract Corporation, Limited, 3, Tokenhouse-bldgs, King's Arms-yard, London, E.C.

Clark (Frank W.) & Co, Limited, 20, Abchurch-lane, London, E.C.

Clarke (J. F.) & Sons, 49, Moorgate-st, London, E.C.

CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**

CORLETT ELECTRICAL ENGINEERING COMPANY, Limited, Rowbottom-sq, Wigan ; and Breightmet-st, Bolton

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London; Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

Cutler (Samuel) & Sons, 16, Great George-st, Westminster, S.W., and Millwall, E., London

Dale's Stores, Bournemouth

Dann, Richard, Invicta Works, Union-st, and 31, High-st, Maidstone

Dawson, Roger, Limited, 53, Berners-st, W., and Stanhope-st, N.W., London

Dennis, T. H. P., Chelmsford, Essex

Dix, G. R., 124, St. John-st-rd, London, E.C.

Dobson, R. & H., 14, Sackville-st, Salford

DRAKE & GORHAM, 66, Victoria-st, London, S.W. **See Advt. p. 15**

Edmundsons, Limited, 19, Great George-st, London, S.W.

Edmundson's Furnishing and Engineering Company, Limited, 33 to 36, Capel-st, and 5, Dawson-st, Dublin

ELECTRIC CONSTRUCTION COMPANY, Lmited, Queen-street-chmbrs, Queen-st, London, E.C. ; and Wolverhampton.

Electric Lighting and General Development Syndicate, Limited, 5, Queen Victoria-st, London, E.C.

Electrical and General Contract Corporation, Limited, 35, Parliament-st, London, S.W.

ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt. on back cover**

Fleming (Hugh) & Co, 1, Teviot-pl, and 3, Rose-st, Edinburgh

Foreign Pilsen Electric Light and Power Company, Ltd, 11, Abchurch-lane, London, E.C.

Fowles (G.) & Sons, Limited, 40 to 47, Green-st, Birmingham

Fyfe-Main Electric Lighting and Construction Company, Electric-avenue, Brixton, London, S.W.

Gatward (John) & Son, Swan Iron Works, Hitchin ; and at Stevenage

Grant & Co, Faraday Works, Leicester ; 3, Maiden-lane, Queen-st, London, E.C. ; 47, High Bridge, Newcastle-on-Tyne ; 27, Oswald-st, Glasgow ; and at Cardiff and Belfast

Gillingwater, G., 25, Balfour-rd, Highbury New Park, London, N.

Gillmore, G., 10, Athol-street, Douglas, Isle of Man

Gorseinon Electric Light Company, Limited, Gorseinon, near Swansea

GREENHILL, J. H., (New) King-st, Belfast. **See Advt., p. 37**

Hall, Beddall & Co, Pitfield Wharf, Commercial-rd, Lambeth, S.E., and 31, Bread-st, E.C., London

Hall (A.) & Co, 1 and 11, South John-st, Liverpool

Haydon, W., 215, Old Christchurch-rd, Bournemouth

Hayne, W. E., 29, Western-rd, Brighton ; and 12, Ella-rd, Crouch Hill, London, N.

Hersey Bros, Limited, 70, Berners-st, Oxford-st, London, W.

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Hewitt, Wm., 74a, Chiswell-st, London, E.C.
Heywood, S. H., 12, Brazenose-st, Manchester
Hills & Thomson, Limited, Imperial-chmbrs, 62, Dale-st, Liverpool
Holmes (J. H.) & Co, Portland-rd, Newcastle-upon-Tyne; and 17, Coleman-st, London, E.C.
Hutchinson, W. B., The Observatory, Liversedge, Yorks
Jackson, John, 3, Victoria-st, London, S.W.
Jenrick & Crocker, 233, Borough, London, S.E.
Joel (Henry F.) & Co, 31, Wilson-st, Finsbury, London, E.C.
Johannesburg Lighting Company, Limited, 6, Great Winchester-st, London, E.C.
Johnson, J. E., Highcross-st, Leicester
JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C., and Victoria Works, Charlton, Kent. **See Advt., p. 3**
LAING, WHARTON & DOWN, 82A, New Bond st, W., and 17, Gracechurch-st, E.C., London; and Guardian-bldg, Manchester. (Thomson-Houston System.) **See Advt., p. 42**
Laing, Wharton and Down Construction Syndicate, Ltd, 38, Parliament-st, London, S.W.
London Electric Supply Corporation, Limited, 3, Adelphi-ter, W.C., and Storage Wharf, Deptford, S.E., London
Lowdon Bros., 21, North Tay-st, and 72, Commercial-st, Dundee
MACCARTHY, C. C., Belfast Electrical Works, 23, Corporation-sq, and 16, William-st South, Belfast. **See Advt., p. 49**
MacIntosh, F., 38, Langham-st, Portland-pl, London, W.
McIntosh, J., 38, Langham-st, London, W.
MANCHESTER EDISON-SWAN COMPANY Limited, Temple-chmbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**
Maple & Co, Limited, 141 to 149, Tottenham Court-rd, London, W.C.
Marr (J. J.) & Co, 18, Moorfields, Liverpool
Marryat, Lillywhite & Co, Dashwood House, New Broad-st, London, E.C.
Massey, W. H., Twyford, Berks; Buckingham Palace, and 25, Queen Anne's-gate, London, S.W.
MATTHEWS & CO, Oxendon-st, Leicester
Mavor & Coulson, 57, West Nile-st, Glasgow
Mellier (C.) & Co, 48, 49, and 50, Margaret-st, Cavendish-sq, and 57, Wells-st, London, W.
Menzies, D. P., 30, Bishop-st, Anderston, Glasgow
METROPOLITAN ELECTRIC SUPPLY COMPANY, Limited, Winchester House, 50, Old Broad-st, London, E.C.
Middleton Electric Light and Power Company, Middleton, near Manchester
Miller & Sons, 178 & 179, Piccadilly, London, W.
More (James) & Co, 77, Renfield-st, Glasgow
Morton (W.) & Co, 127, Sankey-st, Warrington
MUIRHEAD & CO, 2, Princes-st, Great George st, London, S.W. **See Advt., p. 521**
Murphy, W. M., 1, Talbot-st, Dublin
Naylor (W. N.) & Co, 34, Colls-rd, Peckham, London, S.E.
Nickolls, W. H., 58, Clenton-rd, West Green, Tottenham, London, N.
Nunn, C. W. & G., Hertford

OSLER, F. & C., 230, Broad-st, Birmingham; and 100, Oxford-st, London, W.C.
Partington, W. K., Bristol House, Harlesden, N.W., and 3, Willoughby Park-rd, Tottenham, N, London.
PATERSON & COOPER, European Works, Pownall-rd, Dalston, N.E., and 3, Princes-mansions, Victoria-st, S.W., London. **See Advt., p. 39**
Pearce (John) & Co, 182, West Regent-st, Glasgow
Phœnix Electric Light and Power Company, Market-place, Whitehaven
Plowright, J., 27, Railway-rd, Market-st, Lynn
Pound (John) & Co, 81-84, Leadenhall-st, London, E.C.
PYKE, HARRIS & CO, Limited, 33 and 34, New Tothill-st, Westminster, London, S.W.
Rashleigh Phipps & Co, 102, Oxford-st, London, W.
RETTIE, CHARLES, 18, Geraint-st, Liverpool. *Speciality*: *Ship Work*
Riddell, H. G., Cuthbert's-bldgs, Clayton sq, Liverpool
Rowbottom (S.) & Co, Arc Works, Curzon-st, Derby
ROYCE, (F. H.) and CO, Cooke-st, Hulme, Manchester (*Switch Manchester, Nat. 772*)
Rugby School Electric Lighting Company, Limited, Dunchurch-rd, Rugby.
Sanby and Co, 6, Bridge-st, Southampton
Sanderson & Co, Blyth, Northumberland
Sanitary Engineering and Ventilation Company, 65, Victoria-st, London, S.W.
SAX (JULIUS) & CO, Limited, 7, Ridgmount-st, Bedford-sq, W.C., and 366, Central Markets, West Smithfield, E.C., London
Seagar, Laurance, London-rd, Sittingbourne, Kent
Sharp & Kent, 34, Victoria-st, London, S.W.
Sheffield Electric Light and Power Company, Limited, Commercial-st, Sheffield
Shoolbred (James) & Co, 151-156, Tottenham Court-rd, London, W.C.
Sibley (F.) & Co, 7 and 8, Working-st, Cardiff
SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W.; and Woolwich. **See Advt., inside front cover**
Sington (A.) & Co, 31, Portland-st, Manchester
Smith (H. King) & Co, 24, Upper Thames-st, London, E.C.
South, Harry, 10 and 12, Garrick-st, Covent-gdn, and 61 and 62, High-st, Bloomsbury, London, W.C.
SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.
Stansell and Son, East-st and Billet-st, Taunton
Steel (P. B.) & Company, Commercial-st, Dundee
STEGMANN, GEORGE, 69, St. John's-hill, Clapham Junction, London, S.W.
Strode & Co, 48, Osnaburgh-st, N.W., and 67, St. Paul's-churchyard, E.C., London
Suter (Frank) & Co, 66, Berners-st, London, W.
Thomas & Taylor, 80 and 82, Lower Hillgate, Stockport; and 99 and 101, Fonthill-rd, Finsbury Park, London, N.
THOMPSON, N. G., 13, Victoria-st, London, S.W. **See Advt., p. 13**

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Thomson-Houston International Electric Company, 35, Parliament-st, Westminster, London, S.W.
Trollope (George) & Sons, Halkin-st West, and 77, Grosvenor-rd, London, S.W.
Turner (H.) & Son, 28, Villiers-st, Strand, London, W.C.
Ullathorne & Edmondson, 23, Charles-st, Bradford; 10, Basinghall-st, Leeds; and 22 and 24, Imperial-arcade, Huddersfield
United Electric Light Company, 5, Featherstone-bldgs, Holborn, London, W.C.
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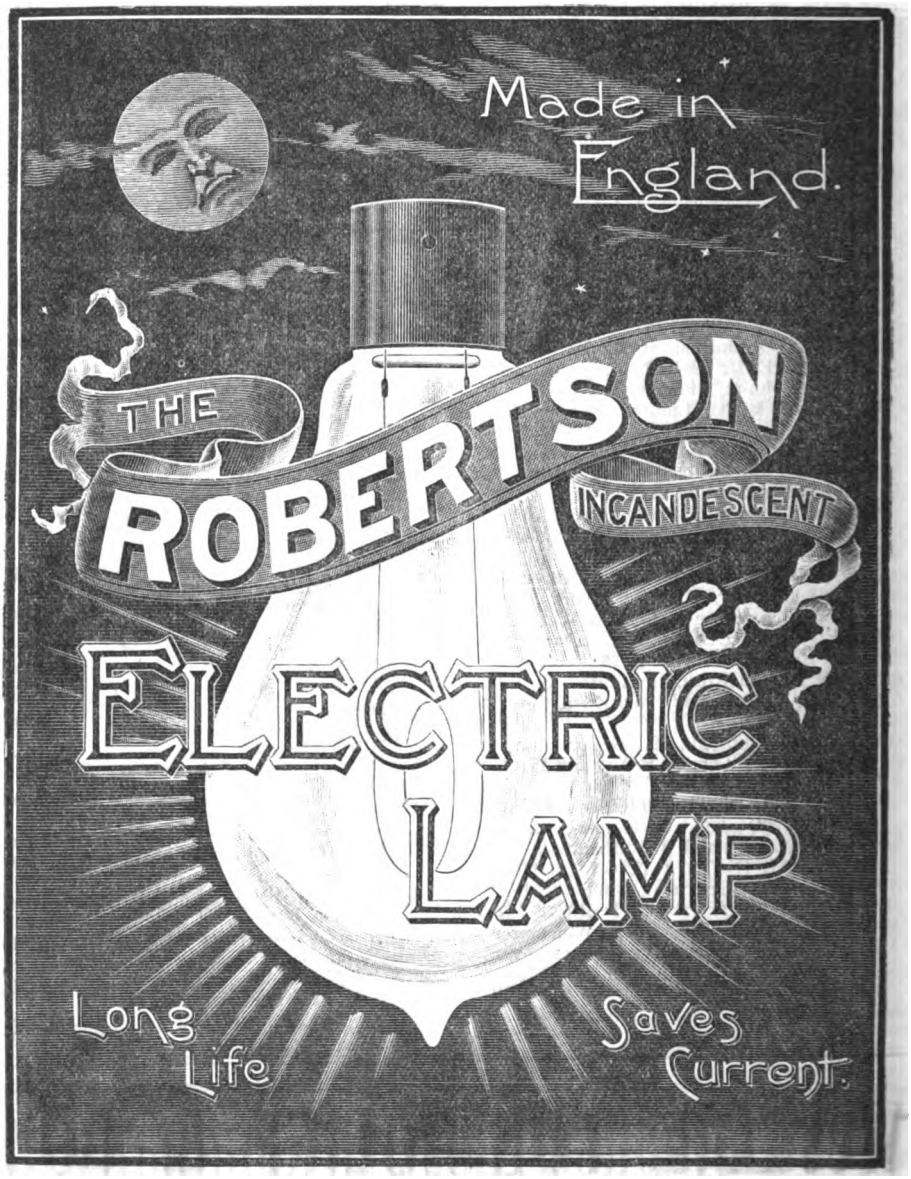

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Chamberlain & Hookham, Limited, 4, New Bartholomew-st, Birmingham
CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**
CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**
Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**
ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st, London, E.C.; and Wolverhampton
ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt., on back cover**
FERRANTI, S. Z. DE, Limited, St. Benét-chmbrs, Fenchurch-st, and 27, Charterhouse-sq, London, E.C. **See Advt., p. 594**
Gulcher (New) Electric Light and Power Company, Limited, Battersea Foundry, London, S.W.
JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C., and Charlton, Kent **See Advt., p. 3**
LAING, WHARTON & DOWN, 82A, New Bond-st, W., and 17, Gracechurch-st, E.C., London; and Guardian-bldg, Manchester. **See Advt., p. 42**
Laing, Wharton & Down Construction Syndicate, Limited, 38, Parliament-st, London, S.W. (Thomson-Houston)
LAURENCE, SCOTT & CO, Limited, Gothic Works, Norwich: and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**
London Electric Supply Corporation, Limited 3, Adelphi-ter, London, E.C.
MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chmbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**
MATHER & PLATT, Limited, Salford Iron Works, Manchester: and 16, Victoria-st, London, S.W. (*Mather Manchester; Bathmetal London*)
SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W. and Woolwich. **See Advt. inside front cover.**
Western Electric Company, 74, Coleman-st, London, E.C.
WESTINGHOUSE ELECTRIC COMPANY, Limited, 32, Victoria-st, London, S.W. **See Advt., p. 487**

ELECTRIC LIGHTING TACKLE MAKERS.

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**
MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. (*Mather Manchester; Bathmetal London*)

ELECTRIC LOCK MANUFACTURERS.

Baxendale & Co, Miller-st, Manchester; and Edinburgh
Chubb & Sons Lock and Safe Company, Limited, 128, Queen Victoria-st, London, E.C.

ELECTRIC MEASURING INSTRUMENT MANUFACTURERS.

(*See also* **Ammeters, Voltmeters, &c.**)

BARKER (FRANCIS) & SON, 12, Clerkenwell-rd, London, E.C. **See Advt., p. 462**
BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, London, S.W. **See Advt., p. 49**

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CROMPTON & CO. Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocers' Hall-ct., Poultry, London, E.C. **See Advt., p. 11**

DRAKE & GORHAM, 66, Victoria-st, London, S.W. **See Advt., p. 15**

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.

ELECTRICAL COMPANY, Limited, 122 and 124, Charing Cross-rd, London, W.C. **See Advt., p. 539**

ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**

FERRANTI, S. Z. DE, Limited, St. Benét-chmbrs, Fenchurch-st., and 27, Charterhouse-sq, London, E.C. **See Advt., p. 594**

GENERAL ELECTRIC COMPANY, Limited 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

GLOVER (W. T.) & CO, Salford, Manchester; and Albany-bldgs, 39, Victoria-st, London, S.W. **See Advt., p. 40**

GOOLDEN (W. T.) & CO, Woodfield Works, Harrow-rd, London, W.

HEMMING (T. L.) & CO, Limited, 88, Snow-hill, Birmingham. **See Advt., p. 36**

LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, 64, Millbank-st, S.W., and 11, Abchurch-lane, E.C., London. **See Advt., p. 602**

Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

MUIRHEAD & CO, 2, Princes-st, Great George-st, London, S.W. **See Advt., p. 521**

NALDER BROS & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 499**

NALDER & HARRISON, Trafalgar House, Great Newport-st, Charing Cross-rd, London, W.C. **See Advt., p. 523**

PATERSON & COOPER, European Works, Pownall-rd, Dalston, N.E., and 3, Princes-mansions, Victoria-st, S.W., London; and 137, West Regent-st, Glasgow. **See Advt., p. 39**

PAUL, ROBERT W., 44, Hatton-gdn, and Leather-lane, London, E.C. **See Advts., pp. 524 and 641**

PITKIN, JAMES, 56, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 491**

SELIG, SONNENTHAL & CO, 85, Queen Victoria-st, and Lambeth Hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7.**

SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W.; and Woolwich. **See Advt. inside front cover**

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

SWINBURNE & CO, Limited, Broom Hall Works, Teddington. **See Advt., p. 637**

Walters (Philip) & Co, 249 and 251, Kensal-rd, and Conlan-st, London, W.

White, James, 16-20, Cambridge-st, Glasgow.

WOODHOUSE & RAWSON UNITED, Limited, 88, Queen Victoria-st, London, E.C. **See Advt., p. 55**

ELECTRIC MINING MACHINERY, MAKERS OF.

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, S.E., London

CLARKE, CHAPMAN & CO, Limited, Victoria Works, Gateshead-on-Tyne; and 121, Fenchurch-st, London, E.C. **See Advt., p. 46**

CORLETT ELECTRICAL ENGINEERING COMPANY, Limited, Rowbottom-sq, Wigan; and Breightmet-st, Bolton

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

DAVIS (J.) & SON, All Saints Works, Derby; and 118, Newgate-st, London, E.C.

ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st, London, E.C.; and Wolverhampton

GOOLDEN (W. T.) & CO, Woodfield Works, Harrow-rd, London, W.

Howell, J. C., Limited, 24, Queen Victoria-st, London, E.C.; and Llanelly, South Wales
Speciality: Electric Hauling, Pumping, Ventilating, &c., Machinery as supplied to all the leading Collieries.

LAURENCE, SCOTT & CO, Limited, Gothic Works, Norwich. **See Advt., p. 45**

MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. *Mather Manchester; Bathmatel London*

Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.

ELECTRIC MOTORS, MAKERS OF.

Akester Electro Motor and Accumulator Company, Limited, 12, Ropemaker-st, London, E.C.

ALLEN (W. H.) & CO, York-st Works, Lambeth, London, S.E. **See Advt., p. 37**

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Hartmann & Braun's $\frac{1}{20}$ to 1 H.P. Motors; very high efficiency.

Battersea—Gulcher (New) Electric Light and Power Company, Limited, Battersea Foundry, London, S.W.

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, S.E., London

"*C. and C.*"—GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

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JAMES PITKIN

Electrical & Scientific Instrument Maker,

56, Red Lion Street, Clerkenwell, E.C.

Telegraphic Address: "BAROGRAPH, LONDON."

SPECIALITIES:

Galvanometers, Cathetometers, Recording Pyrometers, Chronographs, Recording Ammeters and Voltmeters, Firing Keys, Leakage Indicators, Ammeters and Voltmeters.

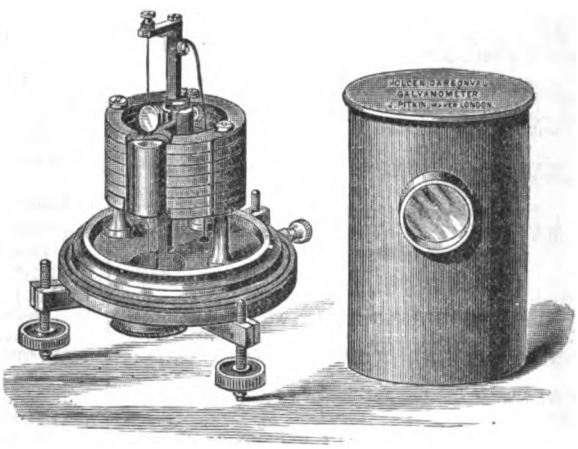
DEAD-BEAT AMMETERS FOR GAS ENGINE, TRAMCAR, AND SHIP WORK.

Cell Testers, Distribution Boards, Switches,

AND

MEASURING INSTRUMENTS OF ALL DESCRIPTIONS.

Improved Secondary Batteries, Portable Electric Safety Lamps for Mines, Gas Works, Petroleum Mills, Gunpowder Mills, Cotton Mills, Hand Lamps, Lamps for Cycling, Travelling or Dramatic Purposes, Surgeons' Lamps, Laryngoscopes, Dental Lamps, Batteries for Cauterizing, &c.



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CASTLE—Holmes (J. H.) & Co, Portland-rd, Newcastle-upon-Tyne; and 17, Coleman-st, London, E.C.

CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**

CLARKE, CHAPMAN & CO, Limited, Victoria Works, Gateshead-on-Tyne; and 121, Fenchurch-st, London, E.C. **See Advt., p. 46**

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

Cuttriss—Cuttriss, Wallis & Co, Limited, Elmwood Electrical Works, Leeds

DAVIS J. & SON, All Saints Works, Derby; and 118, Newgate-st, London, E.C.

EASTON & ANDERSON, Limited, 3, Whitehall-place, London, S.W.; and Erith, Kent. **See Advt., p. 516**

Edwards, A. L., 53, Cowcross-st, London, E.C.

Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.

ELECTRICAL COMPANY, Limited, 122 and 124, Charing Cross-rd, London, W.C. **See Advt., p. 539**

ELWELL-PARKER—Electric Construction Company, Limited, Queen-street-chbrs, Queen-st, London, E.C.; and Wolverhampton

FERRANTI—Ferranti (S. Z. de), Limited, St. Benet-chambers, Fenchurch-st., and 27, Charterhouse-sq, London, E.C. **See Advt., p. 594**

Firth, O., Thornton-rd, Bradford

GARDNER—Gardner (L.) & Sons, Hadfield-street, Combrook, Manchester. **See Advt., p. 48**

GOOLDEN (W. T.) & CO, Woodfield Works, Harrow-rd, London, W.

GREENHILL, J. H., (New) King-st, Belfast. **See Advt., p. 37**

HEMMING (T. L.) & CO, Limited, 88, Snowhill, Birmingham. **See Advt., p. 36**

HINDLEY, E. S., 11, Queen Victoria-st, London, E.C.; and Bourton, Dorset. **See Advts., pp. 553 and 764**

Hookham—Chamberlain & Hookham, Limited, 4, New Bartholomew-st, Birmingham

IMMISCH—Electric Construction Company, Limited, Queen-street-chbrs, Queen-st, London, E.C.

Joel—Joel (H. F.) & Co, 31, Wilson-st, Finsbury, London, E.C.

Lund Bros. & Co, 123 and 125, Oxford-st, London, W.

MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**

MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. *(Mather Manchester; Bathmetal London*

MUIRHEAD & CO, 2, Princes-st, Great George-st, London, S.W. **See Advt., p. 521**

NEWTON ELECTRICAL ENGINEERING WORKS, Taunton

NORWICH—Laurence, Scott & Co, Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**

PHŒNIX—Paterson & Cooper, European Works, Pownall-rd, Dalston, N.E., and 3, Prince's-mansions, Victoria-st, W., London; and 137, West Regent-st, Glasgow. **See Advt., p. 39**

PILSEN ELECTRIC COMPANY, Messrs. Gwynne & Co, Brooke-street Works, Holborn, London, E.C.

Pritchetts & Gold, 31, Soho-sq, W., and Woolwich, S.E., London

Riley, J. S., Riddings, Alfreton, Derbyshire

Salomons—Pyke, Harris & Co, Limited, 34, New Tothill-st, Westminster, London, S.W.

Sherborne Electric Installation, Sherborne, Dorset

SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W.; and Woolwich. **See Advt. inside front cover**

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

STATTER—Statter (J. G.) & Co, Limited, 68, Victoria-st, S.W., and Millwall, E., London. (Telegrams: *Statter London*. Telephone No. *318*) **See Advt., p. 471**

THAMES IRON WORKS AND SHIPBUILDING COMPANY, Limited, Orchard-yd, Blackwall, London, E. **See Advt. inside back cover**

THOMSON-HOUSTON—Laing, Wharton & Down, 82A, New Bond-st, W., and 17, Gracechurch-st, E.C., London; and Guardian-bldg, Manchester. **See Advt., p. 42**

Thomson-Houston International Electric Company, Limited, 35, Parliament-st, London, S.W.

Tyne—Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-upon-Tyne; and 5, Crown-court, Cheapside, London, E.C.

WESTINGHOUSE—Westinghouse Electric Company, Limited, 32, Victoria-st, London, S.W. **See Advt., p. 487**

Yorkshire—Rosling & Matthews, Trafalgar Works, Bradford; and Porter-st, Hull

ELECTRIC ORGANS, MAKERS OF.

Brook (Joseph) & Co, Victoria-rd, Glasgow

Bryceson Bros, 54, Essex-rd, London, N.

Hope-Jones Electric Organ Co, Ltd, 4, Huggin-lane, Queen Victoria-st, London, E.C.; and at Birkenhead

Imhof & Mukle, 110, New Oxford-st, London, W.C.

Murgatroyd, J., Bradford

Young (Alex.) & Son, Manchester

ELECTRIC PUMPING MACHINERY, MAKERS OF.

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, S.E., London

Corlett Electrical Engineering Company Limited, Rowbottom-sq, Wigan; and Breightmet-st, Bolton

ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st, London, E.C.; and Wolverhampton

GARDNER (L.) & SONS, Hadfield-st, Combrook, Manchester. **See Advt., p. 48**

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Hackworth (John H.) & Co, 46, Queen Victoria-st, London, E.C.

Howell, J. C., Limited, 24, Queen Victoria-st, London, E.C.; and Llanelly, South Wales
Pumping Plant already supplied to all the leading Collieries.

Paterson & Cooper, European Works, Pownall-rd, Dalston, N.E., and 68, Victoria-st, S.W., London. **See Advt., p. 39**

Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

Warner (Robert) & Co, 27, Jewin-crescent, London, E.C.; and Engineering Works, Walton-on-the-Naze, Essex

ELECTRIC RAILWAYS AND TRAMWAYS, MAKERS OF AND CONTRACTORS FOR.

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

BLACKWELL, ROBERT W., 39, Victoria-st, London, S.W. **See Advt., p. 525**

Brain, C. T. B., 32, Garmoyle-rd, Liverpool

British Electric Tramways & General Syndicate, Limited, 81, Gracechurch-st, London, E.C.

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, Lambeth, S.E., London

Coventry Electric Tramways, Limited, Coventry

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London, Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chbrs, Queen-st, London, E.C.; and Wolverhampton

ELECTRICAL COMPANY, Limited, 122 and 124, Charing Cross-rd, London, W.C. **See Advt., p. 539**

ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt. on back cover**

EPSTEIN ELECTRIC ACCUMULATOR COMPANY, Limited, 21A, Blythe-rd, West Kensington, W. (*Peroxide London*), and 213, Gresham House, Old Broad-st, E.C. (*Alchymist London*), London. **See Advt., p. 449**

Hobart Electric Tramway Company, Limited, College Hill-chbrs, Cannon-st, London, E.C.

LAURENCE SCOTT & CO, Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**

MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. (*Mather Manchester*; *Bathmetal London*)

SIEMENS BROTHERS & CO, Limited, 12 Queen Anne's-gate, Westminster, London, S.W.; and Woolwich. **See Advt. inside front cover**

TELEGRAPH MANUFACTURING COMPANY, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.

Thomson-Houston International Electric Company, 35, Parliament-st, Westminster, London, S.W.

United Electric Tramways, Limited, c/o Messrs. Siemens Bros. & Co. Limited, 12, Queen Anne's-gate, Westminster, London, S.W.

WESTINGHOUSE ELECTRIC COMPANY, Limited, 32, Victoria-st, London, S.W. **See Advt., p. 487**

ELECTRIC RAILWAY AND TRAMWAY SYSTEMS.

(For list of Electric Railways and Tramways in Great Britain, *see page 159*)

ASKHAM BROS. & WILSON, Limited, Yorkshire Steel and Engineering Works, and Crucible Steel Foundry, Sheffield

Brain, C. T. B., 32, Garmoyle, Liverpool

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, S.E., London

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56, 302, and inside back cover**

ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st., London, E.C.; and Wolverhampton.

ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt. on back cover**

EPSTEIN ELECTRIC ACCUMULATOR COMPANY, Limited, 21A, Blythe-rd, West Kensington, W. (*Peroxide London*), and 213, Gresham House, Old Broad-st, E.C. (*Alchymist London*), London. **See Advt., p. 449**

Gordon Electric Traction Syndicate, Limited, 49, Greenwich-rd, London, S.E.

LAING, WHARTON & DOWN, 82A, New Bond-st, W., and 17, Gracechurch-st, E.C., London; and Guardian-bldng, Manchester. (Thomson-Houston.) **See Advt., p. 42**

MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. (*Mather Manchester*; *Bathmetal London*)

SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, London, S.W.; and Woolwich, Kent. **See Advt. inside front cover**

Telegraph Manufacturing Company, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.

WESTINGHOUSE ELECTRIC COMPANY, Limited, 32, Victoria-st, London, S.W. **See Advt., p. 487**

ELECTRIC SAFETY LAMP MAKERS.

(*See also* **Portable Electric Lamps.**)

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

BRISTOL ELECTRIC SAFETY LAMP WORKS, 63, Queen Victoria-st, London, E.C. **See Advt., p. 601**

BRISTOL, L., Bristol Electric Safety Lamp Works, 40, Great Smith-st, Westminster, London, S.W.

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BRITISH ELECTRIC LIGHT COMPANY, THE, Limited, 11, Delahay-st, Westminster, London, S.W. **See Advt., p. 49**

Edison & Swan United Electric Light Company Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

Epstein Electric Accumulator Company, Limited, 21A, Blythe-rd, West Kensington, W. (*Peroxide London*), and 213, Gresham House, Old Broad-st, E.C. (*Alchymist London*), London. **See Advt., p 449**

LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, 64, Millbank-st, S.W., and 11, Abchurch-lane, E.C., London. **See Advt., p. 602**

MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chmbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**

PITKIN, JAMES, 56, Red Lion-st, Clerkenwell, London, E.C. **See Advt. on p. 491**

Sherborne Electric Installation, Sherborne, Dorset

Swan United Electric Light Company, Limited, 100, Victoria-st, London, S.W.

ELECTRIC SEPARATORS, MAKERS OF.

ASKHAM BROS. & WILSON, Limited, Yorkshire Steel and Engineering Works, and Crucible Steel Foundry, Sheffield

ELECTRIC SIGNALLING APPARATUS (AUTOMATIC) MAKERS.

Automatic Electric Railway Signal Company, Limited, 11, Rumford-pl, Liverpool

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

DAVIS (J.) & SON, All Saints' Works, Derby; and 118, Newgate-st, London, E.C.

DUTTON & CO, Ltd, Railway Signal Works, Worcester; and 70 & 71, Palace-chmbrs, Westminster, London, S.W.

Edwards, Henry Morden, Cardigan Works, Market-place, Wakefield

ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**

Floyd, E. M., 32, Prothero-rd, Fulham, London, S.W.

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

Homacoustic Speaking Tube Company, 22, Queen-st, London, E.C.

Orme's Electric Signal Syndicate, Limited, 65, Barbican, London, E.C.

Railway Signal Company, Limited, Fazakerley, Liverpool; and 16, Eastcheap, London, E.C.

Saxby & Farmer, Ltd, Canterbury-rd, Kilburn, London, N.W.

SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.

Thatcher & Devereux, 15, Chivalry-rd, Battersea, London, S.W. (Patentees)

Walker (Sydney F.) & Co, Cardiff Electrical Works, Severn-rd, and 33, Castle-st, Cardiff

Zohrab & Biggs English Patents, Limited, 6, Adam-st, Adelphi, London, E.C.

ELECTRIC TELEPHONES, MAKERS OF.

(*See also* **Telephones.**)

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

CONSOLIDATED TELEHONE CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 109, Farringdon-rd, London, E.C. (For export)

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

ELECTRIC THERMOSTATS AND GAS REGULATORS, MAKERS OF.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
"*Victory*" *Electric Thermostats*

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

ELECTRIC TOYS, MAKERS OF.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)

Sherborne Electric Installation, Sherborne, Dorset

ELECTRIC TRACTION ENGINEERS.

Baker, W. S. Graff, C.E., Manager Thomson-Houston International Electric Company, 35, Parliament-st, Westminster, London, S.W.

Brain, C. T. B., 32, Garmoyle-rd, Liverpool

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, Lambeth, S.E., London

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ELECTRICAL POWER STORAGE COMPANY, 4, Great Winchester-st, London, E.C. **See Advt. on back cover.**

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Jarman, A. J., 75, Ramsden-rd, Balham, London, S.W.

LAING, WHARTON & DOWN, 82A, New Bond-st, W., and 17, Gracechurch-st, E.C., London; and Guardian-bldg, Manchester. **See Advt., p. 42**

LAURENCE, SCOTT & CO, Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**

MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chmbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**

MATHER & PLATT, Limited, Salford Iron Works, Salford, Manchester; and 16, Victoria-st, London, S.W.

Smith, M. Holroyd, C.E., 161, Trinity-rd, Upper Tooting

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Winslow, I. E., Manager Roundhay Electric Tramway, 1 Roseville-rd, Roundhay, Leeds

WOODHOUSE & RAWSON UNITED, Limited, 88, Queen Victoria-st, London, E.C. **See Advt., p. 55**

ELECTRIC TRAMWAY INSULATORS, AND SUPPLIES.

BLACKWELL, ROBERT W., 39, Victoria-st, London, S.W. **See Advt., p. 525**

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(*See also* **Electric Railway and Tramway Systems**)

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Chloride Electrical Storage Syndicate, Limited, 8, King-st, Manchester

ELECTRIC CONSTRUCTION COMPANY Limited, Queen-st-chbrs, Queen-st, London E.C.; and Wolverhampton

EPSTEIN ELECTRIC ACCUMULATOR COMPANY, Limited, 21A, Blythe-rd, West Kensington, W. (*Peroxide London*), and 213, Gresham-house, Old Broad-st, E.C. (*Alchymist London*), London. **See Advt., p. 449**

ELECTRIC TRANSMISSION OF POWER, CONTRACTORS FOR.

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Chamberlain & Hookham, Limited, 4, New Bartholomew-st, Birmingham

CLARKE, CHAPMAN & CO, Limited, Victoria Works, Gateshead-on-Tyne; and 121, Fenchurch-st, London, E.C. **See Advt., p. 46**

CORLETT ELECTRICAL ENGINEERING COMPANY, Limited, Rowbottom-sq, Wigan; and Breightmet-st, Bolton

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

DAVIS (J.) & SON, All Saint's Works, Derby; and 118, Newgate-st, London, E.C.

Dollander, Robert, 3, York-pl, Halliwell-lane, Manchester

ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-st-chbrs, Queen-st, London, E.C.; and Wolverhampton

ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt. on back cover.**

Epstein Electric Accumulator Company Limited, 21A, Blythe-rd, West Kensington, W. (*Peroxide London*), and 213, Gresham-house, Old Broad-st, E.C. (*Alchymist London*), London. **See Advt., p. 449**

FERRANTI, S. Z. DE, Limited, St. Benét chbrs, Fenchurch-st, and 27, Charterhouse-sq, London, E.C. **See Advt., p. 594**

GOOLDEN (W. T.) & CO, Woodfield Works, Harrow-rd, London, W.

Hall (J. P.) & Co, Blackriding Iron Works, Werneth, Oldham

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Thomson-Houston International Electric Company, 35, Parliament-st, London, S.W.

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King, Mendham & Co, Western Electric Works, Narrow Wine-st, Bristol

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DRAKE & GORHAM, Victoria-st, London, S.W. **See Advt., p. 15**

Dunning, R. H., 7, King's-rd, Windsor

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Rowland (W. H.) & Co, 308, Stretford-rd Hulme, Manchester
SHERBORNE ELECTRIC INSTALLATION, Sherborne, Dorset
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Warden, Willoughby, 60, Robertson-st, Glasgow. (Agent for G. E. Belliss & Co)
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Wright, H. F., jun., 33, Strand, Barrow-in-Furness

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Davis & Co, Limited, Gorleston, Great Yarmouth
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DRAKE & GORHAM, 66, Victoria-st, London, S.W. **See Advt., p. 15**
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Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London ; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**
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ELECTRICAL COMPANY, Limited, 122, and 124, Charing Cross-rd, London, W.C. **See Advt., p. 539**
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Johnson, Thos T., Optical Works, Catharine-st, Salisbury
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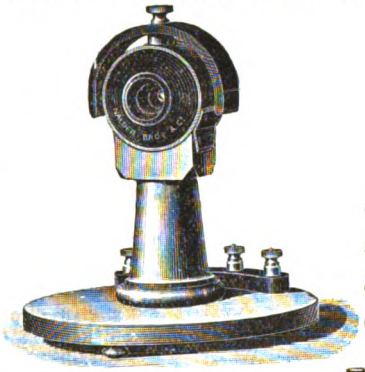

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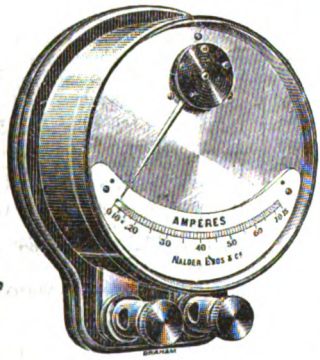

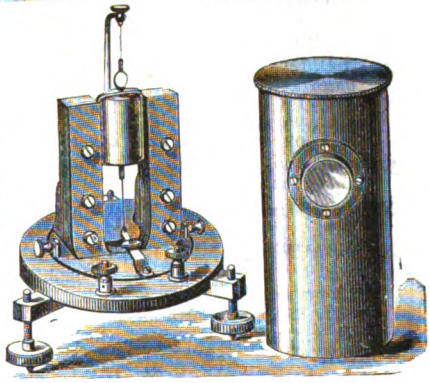

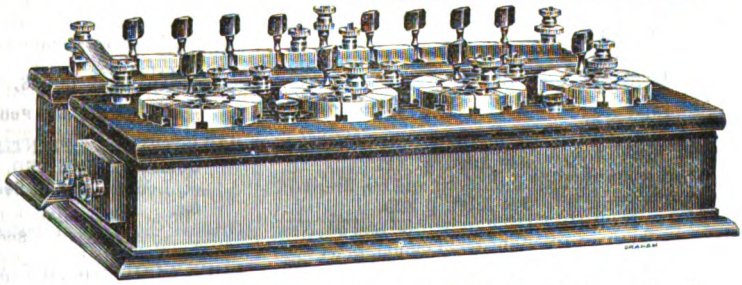

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London Electrical Manufacturing Co, 75, Ramsden-rd, Balham, London, S.W.
Lowcock & Hill, Blackpool
LUNDBERG, A. P., Bradbury Electrical Works, Bradbury-st, Kingsland, London, N. **See Advt., p. 619**
McNamara, —, Park-rd, Moseley, Birmingham
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Morrison (James) & Co, 4, Fenchurch-st, London, E.C.
Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.
MUIRHEAD & CO, 2, Princes-st, Great George-st, London, S.W. **See Advt., p. 521**
NALDER BROS & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt. on preceding page**
NALDER & HARRISON, Trafalgar House, Great Newport-st, Charing Cross-rd, London, W.C. **See Advt., p. 523**
Negretti & Zambra, Holborn-viaduct, London, E.C.
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Perken, Son & Rayment, 99, Hatton-gdn, London, E.C.
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Telegraph Manufacturing Company, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.
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NALDER BROS & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 499**

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ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**

MUIRHEAD & CO, 2, Princes-st, Great George-st, London, S.W. **See Advt., p. 521**

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(*A List of the Officials, and an abstract of the Rules, of this Institution will be found on pp. 257 to 262.*)

a'Court, Sidney, 19, Old Queen-st, Westminster, London, S.W.

Adams, W. P., 2, Cambridge-villas, Roehampton, Surrey

Adamson, D. F., Moorgate-chambers, 72, Finsbury-pavement, London, E.C.

Addenbrooke, G. L., 41, Charing Cross-mansions, Charing Cross-rd, London, W.C.

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Albright, J. F., Mansion House-bldgs, 4, Queen Victoria-st, London, E.C.

Aldridge, J. G. W., 23, High-st, Southampton; and 9, Victoria-st, London, S.W.

Alexander, David, 5, Ardgowan-ter, Glasgow

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Allen & Co, 9, Bridge-st, Westminster, London, S.W.

Allport, Charles James, Woburn-place, Russell-sq, London, W.C.

Allpress & Co, 55, Victoria-st, London, S.W.

Anders G. L., Telephone-bldgs, 31, Queen Victoria-st, London, E.C.

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Andreae Bros., 85, London-wall, London, E.C.

Andreae (Walter) & Co, 179, Victoria-st, London, S.W.

Andrews, J. D. F., 15, Marsham-st, London, S.W.

Andrews, O. M., St. James's and Pall Mall Electric Light Company, Limited, Mason's-yard, Duke-st, London, S.W.

Armour, L. H., C.E., 16, West-st, Gateshead-on-Tyne

Arnot, William, City-chmbrs, George-sq, Glasgow. (To the Corporation)

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Aylmer, R., 47, Victoria-st, London, S.W. (*Leclanché London.*) (Sole Agent for Leclanché's Patent Batteries) **See Advt., p. 17**

Ayrton, Prof. W. E., F.R.S., City and Guilds of London Central Institution, Exhibition-rd, London, S.W.

Bacon, T. Walter, 4, Great Winchester-st, London, E.C.

Bailey, Frank, 17, South-st, Manchester-sq, London, W. (Engineer to the Metropolitan Electric Supply Company)

Baily, F. G., M.A., Assistant Lecturer in Electrotechnics, University College, Liverpool

Baily & Grundy (London), Limited, Amberley Works, Amberley-rd, Paddington, London, W.

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Barclay, W. J., 59, West Clowes-st, Salford

BARKER, CHAS. D., 113, Midland-rd, St. Pancras, London, N.W. **See Advt., p. 580**

Barker, John H., Cambridge Electric Supply Company, Limited, 2, Sidney-st, Cambridge

Barley, C. J., Chapel Place Central Lighting Station, Brompton-rd, London, N.W.

Barnard, A. S., Town Hall, Lancaster (To the Corporation)

Baron, James Thomas, St. Pancras Central Station, 67, Stanhope-st, London, N.W.

Barter, Arthur, 22, Newcomen-ter, Courtham, Redcar

Bartholomew, W., Wardrobe-chbrs, Queen Victoria-st, London, E.C.

Bartlett, Albert T., B.A., 63, Mount-st, Charlton, Kent

BARTON, THOMAS, Electrical Works, Blackburn (*Barton Blackburn, 265*)

Bate, Douglas C., 127, East Dulwich-grove, London, S.E.

Bates, Edwin, 118, Holborn, London, E.C.

Baur, Dr. C., 81, Church-lane, Old Charlton, London, S.E.

Bax, Capt. E. Ironside, Westminster Electric Supply Corporation, Limited, Eccleston-pl, Belgravia, London, S.W.

Baxendale & Co, Miller-st, Manchester; and Edinburgh

Beare, T. Hudson, Engineering Laboratory, University College, Gower-st, London, W.C.

(*For Telegraphic Addresses and Telephone Numbers, see Alphabetical Section.*)

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Bell, Philip H., Edison-Swan United Electric Light Company's Works, Ponder's End, Middlesex, and St. Andrew's-rd, Enfield
Bell, Stuart, Messrs. T. S. McInnes & Co, Limited, 86, York-st, and 34, Argyle-st, Glasgow
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BENNETT, ALFRED ROSLING, 22, St. Albans rd, Harlesden, London, N.W.
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Bergtheil & Young, 13, Walbrook, London, E.C.
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Bessemer, A. G., jun., Whitehall Club, Westminster, London, S.W.
Bidwell, Guy L., Waterhouse Electrical Manufacturing Company, Limited, 67, Southwark Bridge-rd, London, S.E.
Bingham, W. G., M.A., Electric Construction Company, Limited, Queen-street-chmbrs, Queen-st, E.C.; and 29, Notting-Hill-ter, W. London
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Binswanger, Max, 71, Queen Victoria-st, London, E.C.
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Bolton, Alfred S., Moor Court, Cheadle, Staffs.
Bolton, John, 15, Tresco-rd, Linden-grove, Nunhead, London, S.E.
Booth, William H., Westminster Electric Supply Corporation, Limited, Eccleston-pl, Westminster, London, S.W.
Bosanquet, Chas. J., 73, Queen Victoria-st, London, E.C., and Ripley Lodge, Belvedere, Kent
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Bottomley, William, 15, University Gardens, Hillhead, Glasgow
Boult, W. S., Bank-bldgs, 60, Castle-st, Liverpool
Bourne, W. F., 41, Priory-rd, Bedford Park, London, W.
Bowden, H. W., House-to-House Electric Light Central Station, Richmond-rd, London, S.W.
Bowker (William) & Co, 43, Grove st, and 41, Spring-st, Huddersfield
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Clubbe, (E. J.) & Co, 16, Elm-st, Gray's Inn-rd, London, W.C.
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Cockburn, A. C., 23, Streatley-rd, Brondesbury, London, N.W.
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Cook, David, 1 and 2, Great Winchester-st, London, E.C.
Cooke, Conrad W., 28, Victoria-st, London, S.W.
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Cooper, T., M.A., Oxford Electric Light Co, 45, Broad-st, and Spring Valley, Iffley-rd, Oxford
Cooper, Vivian B. D., 5, Victoria-st, London, S.W.
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Cottam, Geo. H., Town Hall, Hanley, Staffs. (To the Corporation)
Couzens, W. H., Electric Light Station, Taunton
Cowan, E. W., Vicarage-lane, Bowdon, Cheshire
Cowley, John, 32A, Tower-bldgs, Water-st, Liverpool
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Crapper, Ellis H., Sheffield Technical School, Sheffield
Crawley, C. W. S., 44, Castleton-rd, West Kensington, W., and 16, Red Lion-st, Clerkenwell, E.C., London
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Dallas, J. Douglas, 10, Trevor-ter, Knightsbridge, London, S.W.
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Darke, W. C., Wilmot-place, Camden Town, London, N.W.
Davey, Henry, 3, Princes-st, Westminster, London, S.W.
Davidson, E. S., 6, Netherall-gdns, South Hampstead, London, N.W.

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Davies, Leonard Randal, 39, Seething-lane, London, E.C.
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Davis, Albert L., Endoby, Guernsey
Davis, Geo. James, Overton, Ormeley-rd, Balham, London, S.W.
Dawbarn, R. A., 49, Queen Victoria-st, London, E.C.
Dawson, Hammond & Co, 4, John-st, London, W.
Dawson, Philip, c/o R. W. Blackwell, 39, Victoria-st, London, S.W.
Day, Arthur A., St. Osyth, Kidderminster-rd, West Croydon
Day, Gerald St. John, 53, Union-street West, Oldham
Deakin, B., Central Lighting Station, 64, Bankside, London, S.E.
Dearlove, Arthur, 4, Great Winchester-st, London, E.C.
Deeley, F. Heath, 6, Carlton House-ter, London, S.W.
Dempster, Albert M., 6, Coleridge-st, Halifax, Yorks.
Denny, A. (Messrs. Wm. Denny & Bros), Leven Ship Yard, Dumbarton
Dew, W. Elsden, c/o Messrs. Sharp & Kent, 34, Victoria-st, S.W.; and 65, Bournemouth-rd, Rye-lane, Peckham, S.E., London
Dickenson, A., Manager Tramway Department, Electric Construction Corporation, Limited, Wolverhampton
Dimier, Paul, 5, Hyde Vale-villa, Blackheath, London, S.E.
Dixon, J. R., Keswick Electric Lighting Co, Stanley-ter, Blencathra-rd, Keswick
Dobbie, Thomas, jun., 58, Pollock-st, Glasgow
Dobson, Sydney T., St James's and Pall Mall Electric Light Company, Limited, Carnaby-st, Golden-sq, W. and Mason's-yard, Duke-st, St. James's, S.W., London
Dolby, E. R., 8, Princes-st, Westminster, London, S.W
Dollander, R., 3, York-pl, Halliwell-lane, Cheetham, Manchester
Donovan, Edward W. (Messrs. J. G. Leach & Co), Mount-street Works, Harpurhey, Manchester
DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocers' Hall-ct, Poultry, London, E.C. **See Advt., p. 11**
Dorman, A. H. (Messrs. Dorman and Smith), 11, Grocer's Hall-court, London, E.C.
Dorman, C. M., M.I.E.E., Ordsal Station Electrical Works, Salford, Manchester
Douglas, R. C., 1, Cunliffe-villas, Manningham, Bradford
Douglas, W., 63, York-pl, Edinburgh
Down, F. J. (Messrs. Laing, Wharton & Down), 82A, New Bond-st, London, W.
Downe, Reginald Sydney, National Electric Supply Co, Limited, 119A, Fishergate, Preston.
Drake, Bernard, 66, Victoria-st, London, S.W.
Drennan, W. H., 44, Mount Charles-av, Belfast
Dundas, T. Duncan, 3, St. Peter's-court, St. Martin's-lane, W.C.; and 78, Cambridge-gdns, Notting-hill, London, W.
Durtnall, W., Cannon-st Hotel, London, E.C.
Dyer, John, Messrs. B. Verity & Sons, King-st Covent-garden, London, W.C.
Earle, H. A., 16, Victoria-st, Westminster, London, S.W.
Ebel, Julius, Julia Cottage, Charlton-lane, New Charlton, London, S.E.
Eck, Justus, c/o Laing, Wharton & Down, 82A, New Bond-st, London, W.
Edgar, James, Milton-villa, Wrexham
Edgcombe, J. E., Central Electric Light Station, Richmond, Surrey
Edmunds, H. (Messrs. W. T. Glover & Co.) Salford, Manchester, and 39, Victoria-st, London, S.W.
Edmundson, J. W., Sunbeam Lamp Company, Limited, Gateshead-on-Tyne
Edwards, Ernest Charles, 31, Ridinghouse-st, London, W.
Ekin, Tom, 12, Little Queen-st, Westminster, London, S.W.
ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st, London, E.C.; and Wolverhampton
Elieson, C. P., 75, Edith-rd, West Kensington, London, W.
Elliott, C. H., Ford-Lloyd Manufacturing Co Limited, 2-8, Mount-pleasant, London, E.C.; and Beckenham, Kent
Elliott, James Mountjoy, 10, Woodquest-av, Herne-hill, London, S.E.
Ellis, Arthur, Cambridge Electric Supply Co's Central Station, Thompson's-lane, Cambridge
Ellis, R., Tiverton
Elsner & Co, Limited, 31, Lombard-st, London, E.C.
Engledue, Col., Byfleet, Surrey
ESSON, W. B., C.E., Messrs. Johnson & Phillips, Charlton, Kent
Estler, Paul, Messrs. Siemens' Works, Charlton, Kent
Eugène-Brown, E., c/o Messrs. J. H. Holmes & Co, Portland-rd, Newcastle-on-Tyne
Everett, W. H., B.E., B.A., 5, Shaftesbury-rd, Brighton
Evershed, Sydney, Woodfield-rd, Harrow-rd, London, W.
Ewing, Prof. J. A., M.A., B.Sc., F.R.S., F.R.S.E., The University, Cambridge
Fahie, Angelo, 9, Westland-row, Dublin; and London, W.C.
Fahie (J. K.) & Son, 9, Westland-row, Dublin
Fairweather, C. W., Corlett Electrical Engineering Co, Limited, 13, Mosley-st, Newcastle-on-Tyne
Fairweather, J. G., B.Sc., College of Science and Technology, 63, Hanover-st, Edinburgh
FALERO, LUIS, 100, Fellows-rd, South Hampstead, London, N.W.
Falkenstein, Conrad K., Holmleigh, Lanercost-rd, Tulse Hill-park, London, S.W.
Fanshawe & Grant, 181, Queen Victoria-st, E.C., and 64, Strand, W.C., London
Farrar, William, Trafalgar Works, Bradford
Farrow, Alfred, Windsor Electric Light Station, Goswell-lane, Windsor
Fawcus, W. P. James, Temple-chbrs, 29, Brazenose-st, Manchester; and Bowdon, Cheshire

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Fellows, Thomas H., 88, Corporation-st, Walsall
Ferguson (J.) & Co, Ballymena, co. Antrim, Ireland
Ferranti, Sebastian Ziani de, 27, Charterhouse-sq, London, E.C.
FERRANTI (S. Z. DE) Limited, St. Benét-chmbrs, Fenchurch-st, and 27, Charterhouse-sq, London, E.C. **See Advt., p. 594**
Fewster, T. W., Lorne-gdns, Regent's Park, London, N.W.
Field, J. H., Claremont, Woodberry Down, London, N.
Field, Michael Birt, Claremont Woodbury Down, London, N.
Fincham, J., Central Electric Light Station, Dublin-st, Carlow
Finlay, W., Messrs. Smiths & Co, Limited, 65, George-st, Edinburgh
Fippard, A. J., Bournemouth
Fleming, Prof. J. A., M.A., D.Sc., F.R.S., 100, Victoria- st, S.W., and University College, Gower-st, N.W., and 9, Clifton gdns, Maida Hill, W., London
Floyd, (Thomas,) & Co, 28, Victoria-st, London, S.W.
Foggin, William, The White House, Washington, Durham
Foote, Henry, 68, Victoria-st, London, S.W.
Foote & Von Buch, 11, Queen Victoria-st, London, E C.
Forbes, Prof. G., M.A., F.R.S., M.Inst.C.E., &c., 34, Great George-st, London, S.W.
Ford, A. C., c/o Thames Iron Works and Shipbuilding Company, Limited, Orchard-yd, Blackwall, London, E.
Ford-Lloyd, Arthur, 2-8, Phœnix-pl, Mount Pleasant ; and 5, Hunter-st, London, W.C.
Ford-Moore, A.P., Stanley House, Windsor
Foster, H. L. T., Resident Engineer, Westminster
Electric Supply Corporation Station, Davies-st, Mayfair, London, W.
Foster, J., Corporation Central Electric Light Station, Nelson
Foulis, William, Corporation Electric Light Station, John-st, Glasgow
Fowkes, —, Bowness
Foyster, A. H., 98, Amity-grove, Cottenham-pk, Wimbledon
Francis, Arthur H. M., c/o Edison-Swan Company, 100, Cannon-st, London, E.C.
Freedman, C. H. 1, Vernon-chbrs, Southampton-row, London, W.C.
Freeman, John G., London Electric Supply Corporation, Station, Blackfriars-rd, London, S.E.
Freund, Edwin, 63, Queen Victoria-st, London, E.C.
Fricker, Guy C., 46, Queen Victoria-st, E.C., and 15, Spencer rd, Putney, S.W., London
Fryer, W. J., Messrs. Graham & Biddle, 463, Oxford-st, W., and Danecroft, Silverdale, Sydenham, S.E., London. (3596)
Fuller & Tate, 20, Bucklersbury, Queen Victoria-street, London, E.C.
Fulton, T. Crichton, 74, Buchanan-st, Glasgow
Furse, W. J., 17, Burton-st, Nottingham
Fyers, Evan W. H., Electrical Installation Company, Limited, 64, Victoria-st, London, S.W.
Fyfe, A.L., Electric-avenue, Brixton, London, S.W.
Galpin, W., 111, Church-rd, Fratton, Portsmouth
Garnett, Prof. W., London County Council, Spring-gdns, London, S.W.
Gatehouse, T. E., 60, Gresham-rd, Brixton, London, S.W.
Gatward, J. W., Swan Ironworks, Hitchin
Gee, W. W. Haldane, Manchester Technical School, and 124, Roby-st, Moss-lane, E., Manchester
Geipel, William, Brush Electrical Engineering Company, Limited, 112, Belvedere-rd, Lambeth, London, S.E.
Gibbings, A. H., Town Hall, Hull. (To the Corporation)
Gibbings, W., Mersey View, Widnes
Gibbs, J. Sidney, 52, Queen Victoria-st, London, E.C.
Gibson, Joseph R., 312, Kennington Park-rd, London, S.E.
Gideon, Edgar T., 38, Gordon-rd, Ealing, London, W.
Giles, Bertram S., c/o Messrs Mather and Platt, Limited, Salford, Manchester
Glyde, Thomas, St. George's-rd, Freemantle, Southampton
Golding, R., Picton Reading Rooms, William Brown-st, Liverpool
Goodman & Simpson, 9, Tottenham st, London, W.
Goodwin, James, 3, North-st, Pentonville, London, N.
Gordon, F. W. Beauchamp, 4, Park-pl, St James's, London, S.W.
Gordon, William, 17, Jeffrey-st, Camden Town, London, N.W.
Gorham, J. M., 66, Victoria-street, London, S.W.
Gourlay, Alex. 35, George-st. Stranraer, N.B.
Gowdy, Samuel Henry, 5, Bentinck Villas, Newcastle-on-Tyne
Graham, Alfred 32, De Crespigny-pk, Denmark-hill, S.E. ; and 2, Princes-st, Westminster, S.W., London
Graham, Henry C., 20, Eastlake-rd, Loughboro' Junction, London, S.E.
Grant (J. O.) & Cocks, Copthall House, Copthall-avenue, London, E.C.
Grave, Herbert de, 1, Amberley-rd, West-hill, Sydenham, London, S.E.
Gravier, Alphonse, J., 11, Colby-rd, Upper Norwood, London, S.E.
Gray, Prof. A., University College of North Wales, Bangor, N. Wales
Gray, James H., B.Sc., Physical Laboratory, The University, Glasgow
Greener, Arnold, K., Oxford Electric Company, 45, Broad-st, Oxford
Greener, W. B., Knutsford-rd, Grappenhall-rd, near Warrington
Greenhalgh, William, 29, Carlton-st, Leeds
Grimshaw, C. O. (Westminster Electric Supply Corporation, Limited), Eccleston-pl, London, S.W.
Grindrod, J. K., Oulder Hill, Rochdale
Grove, A. S. (Thompson, Ritchie & Co, Limited), 48, James-st, Buckingham Gate, London, S.W.
Grove, Charles E., Thames Iron Works and Shipbuilding Company, Limited, Blackwall, London, E.

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Grundy, A., Messrs. Baily & Grundy (London), Limited, Amberley Works, Paddington, London, N.W.

Gullette, Wm., L., 1, White Horse-alley, Cowcross-street, London, E.C.

Gunn, F., Corporation Art Gallery, Mosley-st, Manchester

Guy, F. A., 349, Liverpool-rd, London, N.

Guy, William, Waterloo Grain Warehouse, Waterloo Dock, Liverpool

Gye, Percy, 99, Inverness-ter, Hyde-pk, London, W.

Haines, Robert, 45, St. John-st, Smithfield, London, E.C.

Hale, H. G., 37, High-st., Grantham

Hall, Charles, Redhill, Surrey

Hall, C. J., Leeds and London Electrical Engineering Company, Limited, Steam Plough Works, Leeds

HALL, H. CUTHBERT, 52, Queen Victoria-st, London, E.C.; and Eversley, Elmfield-rd, Bromley, Kent

Hall, J., Messrs. W. T. Henley's Telegraph Works Company, Limited, 27, Martin's-lane, Cannon-st, London, E.C.

Hall, J. I., 5, Shandon Crescent, Merchiston, Edinburgh

Hamilton (Claud) & Co, 137, Waterloo-st, Glasgow

Hammond, R., 117, Bishopsgate-st, London, E.C.

Hancock, C. E., 3, Peter's-court, St. Martin's-lane, W.C., and 3, Inkerman-ter, Kensington, S.W., London

HANDLEY, ARTHUR, Messrs. D. and G. Graham, Clarence Works, Glasgow

Hands (Alfred) & Co., 113, Leadenhall-street, London, E.C.

Hardt, M. P., 63, Queen Victoria-st, London, E.C.

Hardy, John T., 38, Union-st South, Halifax

Harford, Geo. J., 36, Bath-st, Southport

Harker, J. D., 78, King-st, Manchester

Harris, H. Graham (Bramwell & Harris), 5, Great George-st, London, S.W.

Harris, Leverton, 92, Palace Gardens-ter, Campden Hill, London, W.

Harris, Thomas A., Phœnix Works, Collingwood-st, London, S.E.

Harrison, Hugh Erat, B.Sc., B.A., Faraday House, Charing Cross-rd, London, W.C.

Harrison, Thos. H., Bellevue, The Grove, Wandsworth, London, S.W.

Harrison, A. F., West Lexham, Swaffham, Norfolk

Harrison, F., Lyric Chambers, Whitcomb-st, London, W.

Harrison, F. O., Galway Electric Company, Newtownsmyth, Galway, Ireland

Harriss, G. M., Central Electric Light Station, Bray, Ireland

Hart, Francis G., 28, Victoria-st, Westminster, London, S.W.

Hartmans, G. E., 8, Woodville-rd, Ealing, London, S.W.

Hatt, J. J., 4, St. Mary's-ter, Maida-hill, London, W.

Hawkins, T., The Newton Electrical Engineering Works, Taunton

Hawkins, E., The Lodge, Newton-le-Willows, R.S.O., near Bedale, Yorks

Hawtayne, W. C. C., 3, Prince's-mansions, Victoria-st, London, S.W.
Consulting Electrical Engineer to the Corporation of Maidstone, the Harrow Local Board, &c.

Hayne, Richard W., 6, Normand-mansions, West Kensington, London, W.

Haywood, H. W., 20, Upper Maudlin-st, Bristo

Headley, F. H., Central Station, St. Austell' Cornwall

Heap, C. P., 60, Waldegrave-park, Strawberry Hill, London, S.W.

Heaphy, Musgrave, C.E., Phœnix Fire Office, 19, Lombard-st, London, E.C.

Hearder, W., 23, Athenæum-st, The Hoe, Plymouth

Heath (Percy T.) & Co., 17, Little Britain, London, E.C.

Hedges, Killingworth, 7, Carteret-st, Westminster, London, S.W.

Henderson (H. A.) & Co, 60, Upper Jackson-st, and 3, Chapman-st, Hulme, Manchester

Heenan, W. E., Northampton Electric Light and Power Company, Limited, Angel-lane, Northampton

Hemingway, C. A., 10, Petersham-rd, Richmond, Surrey

Hemmant, W., Bulimba, Sevenoaks, Kent

Henry, —, 53, Stanbury-rd, Lugard-rd, Peckham, London, S.E.

Henton, F. W., 249, Tufnell Park-rd, London, N.W.

Henton, A. E., 35, Harrow-rd, Paddington, London, W.

Hesketh, John, Blackpool. (To the Corporation)

Hewett, John, 14, Mill-st, Hanover-sq, London, W.

Hewett, J. H. C., The Primrose Club, 4, Park-pl, St. James's, London, S.W.

Hewett & Oakes, 14, Mill-st, Hanover-square, London, W.

Heys, William Edwin, 70, Market-st, Manchester

Hibbert, C., Rushmore Lodge, Rushmore-rd, Clapton, London, N.E.

Hill, A. D., 63, Ashley-gdns, Victoria-st, London, S.W.

Hill, Chas. Henry, Waverley Lodge, Lower Richmond-rd, Putney, London, S.W.

HILL, CLAUDE W., Messrs. Paterson & Cooper, European Works, Pownall-rd, Dalston, N.E., and Eversleigh, Claremont-rd, Highgate, N., London.

Hill (Thomas) & Co, 12 to 30, Spoutmouth, Glasgow

Hockley, N., J., Brighton Corporation Electricity Works, North-rd, Brighton

Hodges, H. C., 82, Turnmill-st, London, E.C.

Hodges, P. W. O., 82, Turnmill-st, London, E.C.

Hodgkin, C. E., Brush Electrical Engineering Company, Limited, Belvedere-rd, Lambeth, London, S.E.

Hodgson (Frederick) & Co, 56, Gresham-st, London, E.C.

Hogg, H. E., 80, Coleman-st, London, E.C.

Holbrow, C. A., Central Electric Light Station, Manchester-square, London, W.

Holdom (S.) & Co, 2, Great Russell-st, London, W.C.

Hollingsworth, H. C., Electric Light Department, G. W. Railway, 150, Westbourne-ter} Paddington, London, W.

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Holmes, A., Bromley, 36, Princes-avenue, and 15, Highfield-st, Liverpool
Holmes, J. H., A.M.I.C.E., M.I.E.E., Wellburn, Jesmond-rd, Newcastle-on-Tyne
Holmes, L. W. (Messrs. J. H. Holmes & Co), 17, Coleman-st, London, E.C.
Holmes, Philip, 154, Camberwell-grove, London, S.E.
HOME TELEPHONE COMPANY, Limited, 85, Queen Victoria-st, London, E.C. **See Advt., p. 632.**
Hookham, George, M.A. (Messrs. Chamberlain & Hookham, Limited), 4, New Bartholomew-st, Birmingham
Hooydonk, F. Van, 750, Holloway-rd, London, N.
Hope-Bridie, R., 8, St. Benet-pl, London, E.C.
Hopkinson, Charles, M.I.C.E., Princess-st, Manchester
Hopkinson, Dr. E., Salford Iron Works, Manchester
Hopkinson, Dr. J., M.A., F.R.S., Westminster-chmbrs, 5, Victoria-st, London, S.W.
Hornidge, Edward, 423, Kingsland-rd, London, N.E.
Howell, E. James, 45, Willow-rd, Birmingham
Howell, T. J., 74, Buttesland-st, East-rd, Hoxton, London, N.
Howells, —, Pontypool Electric Light and Power Company, Limited, Club-chambers, Pontypool, Mon.
Humble, George, 22, Fawcett-rd, Sunderland
Humphreys, T., Bright Brothers' Mill, Fieldhouse Mills, Rochdale
Hunt, A. Marshall, 14, Prince-st, Bristol
Hunter, Charles L., Central Electric Light Station, Bute Docks, Cardiff.
Hunter, David, Lanark.
Hunter & Oliver, 67, Tottenham Court-road, London, W.
Hutchings, Clarence D'Oyley Holly-grove, Feltham Hill, Middlesex
Hutchinson, Richard R., Pear Tree House, Fulham-rd, London, S.W.
Iles, C. H., 38, Larches-lane, Wolverhampton
Immisch, Moritz, 48, Tollington-pk, London, N.
Inglis, Hugh, Frodingham, near Doncaster.
Ireland, A. J., 13, Minch-avenue, Harlesden, London, N.W.
Irvine, H. A., c/o Albright & Wilson, Limited, Oldbury, Birmingham
Isitt & Co, 39, Victoria-st, London, S.W.
Jackson, A. W., 7, Thayer-st, Manchester-sq, London, W.
Jackson, F. H., City of London Electric Lighting Company, Limited, 1 & 2, Great Winchester-st, London, E.C.
Jackson, H. F., 85, Queen Victoria-st, London, E.C.
Jamieson, Prof. Andrew, F.R.S.E., M.Inst.C.E., Glasgow and West of Scotland Technical College, Glasgow
Jarman, A. J., 41, St. John's-hill, Clapham Junction, London, S.W.
Jeckell, J. A., Town Hall, South Shields (to the Corporation)
Jeffery, S. F., Royal Albert Music Hall, 6, Victoria Dock-rd, Canning Town, London, E.
Jenkins, Fred., Wynyard Park, Stockton-on-Tees
Jenkinson, B. Holmes, c/o Messrs. Crompton & Co, Limited, Mansion House-bldgs., Queen Victoria-st, London, E.C.
Jennings, E. J., Royal Insurance-bldgs, Newcastle-on-Tyne ; and 759, Old Kent-road, London, S.E.
Johnson, William, Sheffield Electric Light and Power Company, Limited, Sheffield
Johnston, Duncan W., Faraday Electrical Works, Govan, Glasgow
Johnstone, W. H., Howe Electrical Works, 13, Smithdown-lane, Liverpool
Jones, Charles, Gorsbrook house, Stafford-rd, Wolverhampton
Jones, F. W. E., Central Electric Light Station, Leamington
Jones, G. H., 12, Addison-gdns, London, W.
Jones, Walter F. (Messrs. W. T. Goolden & Co) Woodfield Works, Harrow-rd, London, N.
Joyce, Samuel, jun., Manchester Technical School, Manchester
Kapp, Gisbert, 31, Parliament-st, London, S.W.
Kelvin, Lord, P.R.S., The University, Glasgow
Keen, H. E., New British Electric Installation Contractors, Limited, 21, Broad-st, Worcester
Kennedy, Prof. Alex. B. W., 14, Old Queen-st, Westminster, London, S.W.
Kennedy, Rankin, Manager Electrical Department, Messrs. Gwynne & Co, Brooke-street Works, Brooke-st, Holborn, London, E.C.
Kierzkowski-Steuart, Charles F. de, 4, Copthall-bldgs, London, E.C.
Kieser, W. (Messrs. Elliott Bros), 101, St. Martin's-lane, London, W.C.
Kilgour, M. H., 18, Regent-st, Cheltenham
KINCAID, WALLER & MANVILLE, 29, Great George-st, London, S.W.
Kipping, P. P., 34, Allerton-rd, Lordship Park, London, N
Knight, E. W., Junior Athenæum Club, Piccadilly, London, W.
Knight, F. W. A., 2, Vanbrugh-ter, Blackheath, London, S.E.
Knight, Geo. A., 4, Donaldson-rd, Kilburn, London, N.W.
KING, FRANK, M.I.E.E., 39, Victoria-st, London, S.W. (*Consonance London*)
King, Thomas, 110, Cannon-st, London, E.C.
Kingsland, William, 17, Avenue-rd, St. John's Wood, London, N.W.
Koerner, Herman, 58, Oxford-rd, New North-rd, London, N.
Kolle, H. W., 27, Charterhouse-sq, E.C., and Egremont, Tulse-hill, S.W., London
Lacey, Ernest M., 28, Linden-gdns, Bayswater, London, W.
Lacey, F. W., Central Electric Light Station, Bournemouth
Lamb, James, Strathearn House, Crieff
Lancaster, Edward W., 52, Bristol-rd, Birmingham
Langdon-Davies, C., 45, Redcliffe-sq, South Kensington, London, S.W.
Langdon-Davies, Walter, 57, Comeragh-st, West Kensington, London, W.
Lange, Ernest F. (Messrs. Beyer, Peacock & Co), Gorton Foundry, Gorton, Manchester
LATIMER CLARK, MUIRHEAD & CO, 23, Regency-st, Westminster, S.W. **See Advt., p. 59**

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Lauckert, E., Maryon-rd, New Charlton, Kent
LAURENCE, SCOTT & CO, Limited, Gothic Works, Norwich ; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**
Lawson, A. J., Dover Electricity Supply Company, Ltd, 49, Queen Victoria-st, London, E.C.
Lea, Frank B., Westcroft-rd, Carshalton, Surrey
Lea (Henry) & Thornbery, 38, Bennet's-hill, Birmingham
Leach, H. L., St. James' and Pall Mall Electric Light Company, Limited, Carnaby-st, Golden-sq, London, W.
Lee, J. H., Southampton Electric Light & Power Co, Ltd, Back-of-the-Walls, Southampton
Legg, F. G. I., Messrs. Spiers and Pond, Waterlane, New Bridge-st, London, E.C.
Le Souef, Henry John, Aurora Electric Lighting and Distribution Company, Limited, 54, New Broad-st, London, E.C.
Lewis, F. Harman, Town Hall, Wolverhampton, (Borough Engineer)
Lewis, J. Slater, Messrs. W. T. Goolden & Co, Woodfield Works, Harrow-rd, London, W.
Lewis, Joseph, 5 and 6, Great Winchester-st, E.C., and 37, New Oxford-st, W.C., London
Lichtenfeld, Sigismund, 300, Regent-st, London, W.
Liebert, E. H., c/o E. Liebert, Ivy Villa, Victoria-rd, Manchester
Lironi, Vittorio G., Walnut Tree House, Leytonstone
Little, C. W. G., Thomson-Houston International Electric Company, 38, Parliament-st, London, S.W.
Littleboy, T. Graham, Manager English Electric Carbon Co, Limited, Carbon Works, Brymbo, near Wrexham
Livingstone, J., Glasgow and West of Scotland Technical College, 38, Bath-st, Glasgow
Loeffler, Ludwig, 12, Queen Anne's-gate, Westminster, London, S.W.
Login, Louis C., 7, Randolph-cliff, Edinburgh
Long, F. M., Norwich Electricity Co's Central Station, Norwich
LORRAIN, J. G., Norfolk House, Norfolk-st, Strand, London, W.C. **See Advt., p. 573**
Lowdon, D., Barry Graving Dock and Engineering Company, Limited, Cardiff
Lowry (W.), Mellie & Co, 48-50, Margaret-st, Cavendish-sq, London, W.
Lucas, C., White Hart Hotel, Windsor
LUNDBERG, A. P., Bradbury Electrical Works, Bradbury-st, London, N. **See Advt., p. 619**
Lundberg, Gus. C., Bradbury Electrical Works, Bradbury-st, London, N.
Lynd, W., 52, Fore-st, E.C., and 132, Adelaide-rd, N.W., London
MACCARTHY, C. C., Belfast Electrical Works, 23, Corporation-sq. and 16, William-st South, Belfast. **See Advt., p. 49**
McCausland, H. A., Gulcher (New) Electric Light and Power Company, Limited, Battersea Foundry, S.W., and 122, Sinclair-rd, Kensington, W., London
McClellan & Co, 35, Ludgate Hill, London, E.C.
McCowen, Victor A. H., Killarney Electric Light Co, Ltd, Killarney, and Barrow House, Tralee
McEvoy, C. A., 69, Victoria-st, London, S.W.
McLauchlan, S. L. D., Birmingham Electric Supply Co, Ltd, 14, Dale End, Birmingham
McLaughlin, S. W., 1, Booth-st, Handsworth, Staffs.
McLean, J. H., Oxford Electric Company, Limited, 45, Broad-st, Oxford
McMullen, J. A., 21, Carlton-hill, St. John's Wood, London, N.W.
McWhirter, William, Faraday Electrical Engineering Company, Limited, Faraday Electrical Works, Govan, Glasgow
Macdonald, E. W. J., Metropolitan Electric Supply Co, Limited, 17, South-st, Manchester-sq, London, W.
MacFarlane, Norman, Central Electric Light Station, Glasgow
Mackay, Alex. Ross, 10, Graham-st, Edinburgh
Madgen, W. Leonard, Faraday House, Charing Cross-rd, London, W.C.
MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chmbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**
Manley, J. W., 7, Thayer-st, Manchester-sq, London, W.
MANVILLE, E., 29, Great George-st, London, S.W.
Marillier, Harry C., 36, Rosetti-mansions, London, S.W.
Markby, Walter, 155, Westbourne-ter, London, W.
Marr, A., Collier-Marr Telephone and Electrical Manufacturing Company, Limited, Derby-st, Oxford-rd, Manchester
Marsden, A., c/o Messrs. Paterson & Cooper, European Works, Pownall-rd, Dalston, London, N.E.
Marsh, H., 107, Church-lane, Charlton, London, S.E.
Marsh, T. A., 69, Brook Green, Hammersmith, London, W.
Martin (W. C.) & Co, Clydedale Bank-bldgs, Argyle-st, Glasgow
Massey, W. H., Twyford, Berks ; Buckingham Palace, and 26, Queen Anne's-gate, London, S.W.
Mavor, Alfred E., General Manager Fowler-Waring Cables Company, Limited, North Woolwich, London, E.
Mavor, Sam, 57, West Nile-st, Glasgow
Maxwell, David, East Dock-st, Dundee
Maycock, W. Perren, 26, Stafford-rd, Croydon
Meadowhurst, B., Woodside-lane, North Finchley, London, N.
Merriman, Will. H., 51, Stockwell-rd, London, S.W.
Mendham, W. P., Western Electrical Works, Bristol
Metzger, Gus. F., City of Bath Electric Light and Engineering Company, Bath
Middleton, P. C., Messrs. New & Mayne, 9, Bridge-st, London, S.W.
Middleton, V. G., 68, Victoria-street, London, S.W.
Millar, C. H., 15, College-st, Belfast
Miller, Francis, B.A., c/o Guy Fricker, 46, Queen Victoria-st., London, E.C.
Miller, H. W., Central Electric Light Station, 148, Brompton-rd, London, S.W.
Miller, Thomas L., 7, Tower-bldgs, Water-st, Liverpool

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Milne, J., South Lodge, Aboyne, Aberdeenshire
Milne, Leonard, 68, Victoria-st, London, S.W.
Mitchell, G., 47, Victoria-st, London, S.W.
Mitchell, W., Saltley Works, Birmingham
Mittelhausen, Julius, 28, Wood-st, Woolwich, London, S.E.
Moir, James, Glasgow Athenæum, St. George's-pl, Glasgow
Möller, G. F., 9, Brussels-rd, New Wandsworth, London, S.W.
Monckton, C. C. F., 4, Edith-rd, West Kensington, London, W.
Monson, Philip, A.I.E.E., Town Hall, Kensington High-st, London, W.
Moody, H. N., 66, Victoria-st, Westminster, London, S.W.
Morgan, W., Drury Lane Theatre, Drury-lane, London, W.C.
MORGAN WILLIAMS & KING, 39, Victoria-st, London, S.W. (*Consonance London*)
Mountain, W. C. (Ernest Scott & Mountain, Ltd.), Close Works, Newcastle-upon-Tyne
Moore, G. Arbuthnot, The Thorns, Bebington, Cheshire
Moore, James, Bolton
Morris, A., Howden, Yorks.
Mountain, A. B., Gas Works-st, Huddersfield (to the Corporation)
Mountstephen, J. T., Electric Light Works, Killarney, co. Kerry
Mudford's Arrow Electrical Works, Jackson-rd Holloway, London, N.
MUIRHEAD & CO, 2, Princes-st, Great George-street, London, S.W. **See Advt., p. 521**
Muirhead, John, 23, Regency-st, Westminster, London, S.W.
Munro, J. M. M., 136, Bothwell-st, Glasgow
Munro, H. D., Central Electric Light Station, New North-rd, Exeter
Murray, E. T. Ruthven, Town House, Aberdeen
Murray, Angus, Anderson Foundry, Glasgow
Murray, T. B., Heavyside, Biggar, N.B.
Naftel, P. H., 15, Highfield-st, Liverpool
Neill, Geo., 57A, South Molton-st, London, W.
Nalder, F. H., 16, Red Lion-st, Clerkenwell, London, E.C.
Nalder, H., 16, Red Lion-street, Clerkenwell, London, E.C.
Nebel, L., c/o Messrs. Siemens Bros. & Co, Limited, 12, Queen Anne's-gate, Westminster, London, S.W.
Newington, F., Westminster Electric Supply Corporation's Central Electric Lighting Station, Millbank-st, Westminster, S.W.
Newitt, L., Sir W. G. Armstrong, Mitchell and Co, Limited, Newcastle-on-Tyne
Newton, F. M., Newton Electrical Engineering Works, Taunton
Nicholls, T. O., 19, Corporation-st, Manchester
Nicoll, Henry, 69, Lowndes-sq, London, S.W.
Nisbett, G. H., British Insulated Wire Company, Limited, Prescot, Lancs.
Nixon, F. A., Central Station, Eccleston-pl, London, S.W.
NUSSBAUM, G. A., General Agent for the Société Industrielle des Téléphones, 29, Ludgate-hill, London, E.C.
Nuthall, B., Ivy Side, King's-rd, Kingston-on-Thames
Oates, H. C., 55, Compton-rd, Wolverhampton
O'Gorman, M. J. P., 14, King-st, Portman-sq, London, W.
Oldham, Frederick E., 60, Chester-rd, Upper Holloway, London, N.
Oliver, Jesse, 299, Meanwood-rd, Leeds
Oliver, W. M., Leeds and London Electrical Engineering Company, Limited, Steam Plough Works, Hunslet, Leeds
Olliver, G. H., 17, St. Helen's-pl, London, E.C.
Olsson, Gustaf, 125, Everton-rd, Manchester
Olver, Graham T. W., 33, Montague-pl, Russell-sq, London, W.C.
Olver, W. Slade, 33, Montague-pl, Russell-sq, London, W.C.
Ommanney, Wm. E., 185, Victoria-st, London, S.W.
Padgham, Thomas, 4, Queen Anne's-mansions, London, S.W.
Page, Charles, 2, Beaufort-gardens, St. John's, London, S.E.
Page, H., 63, Queen Victoria-st, London, E.C.
Paisley, David, 132, Park-lane, Tottenham, London, N.
Palgrave, A. G., Speaker's Court, Palace of Westminster, London, S.W.
Pank (A.) & Son, Bedford-st, St. Andrews, Norwich
Parfitt, G. J. T. J., Keynsham, Bristol
Parker, Mark, Strood, Rochester
Parker, Thomas, F.R.S., M.I.C.E., M.I.E.E., New Bridge House, Wolverhampton (Works Director of the Electric Construction Company, Limited)
Parr, John, 23, Market-st, Nottingham
Parry, Evan, City of London Electric Lighting Co, Limited, 1 and 2, Great Winchester-st, London, E.C.
Parsons, Hon. C. A., Heaton Works, Newcastle-on-Tyne
Parsons, J. Hardy, 87, Hinckley-rd, and Faraday Works, Leicester
Paterson & Cooper, European Works, Pownall-rd, Dalston, N.E., and 68, Victoria-st, S.W., London; and 137, West, West Regent-st, Glasgow **See Advt., p. 39**
Paterson, E. J., European Works, Pownall-rd, Dalston, N.E., and 3, Prince's-mansions, Victoria-st, S.W., London
Patterson, Alfred Edwin, 65, Galleywall-rd, Rotherhithe, London, S.E.
Paton, Frederick, Blackburn, Dulwich Wood Park, London, S.E.
Payne, Ernest, M.A., 39, Victoria-st, London, S.W.; and Hatchlands, Cuckfield, Sussex
Payne, H. J., 1, River-view, The Terrace, Barnes, London, S.W.
Peake, R. E., c/o Messrs. Clark, Forde & Taylor, 4, Great Winchester-st, London, E.C.
Pearce, J. E., Newtownsmyth, Galway
Pease, John, Valley Mills, Apperley Bridge, Yorks.
Peck, G. S., Scarborough Electric Supply Company, Limited, 102, Westborough, Scarborough
Peddie, Henry James, 22, Partington-pl, Edinburgh
Peers, Geo. R., 34, Memorial-rd, Walkden, Bolton-le-Moors
Pegg, R. C., Garrick Theatre, Charing-cross-rd, London, W.C.

(*For Telegraphic Addresses and Telephone Numbers, see Alphabetical Section.*)

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Perry, J., Galway Electrical Company, Newtonsmyth, Galway
Peschek, J., Palace Theatre, Cambridge-circus, London, W.C.
Petchey, Arthur J., 86A, Ford-rd, Roman-rd, London, E.
Peters, Philip, 31, Schubert-rd, Putney, London, S.W.
Philipps, W. Rees, 98, Victoria-st, London, S.W.
Phillips, A. F., 31, Gt. George-st, Westminster, London, S.W.
Phillips, J. A., 50, Linthorpe-rd, Stamford-hill, London, N.
Picken, William, 2, Prospect-ter, Babbicombe, near Torquay
Pickering, J. R., 126, Holmesdale-rd, South Norwood, London, S.E.
Pierce, Edwin, 19, Station-rd, South Norwood, London, S.E.
Piggott, George E., "The Valley," Bromley, Kent
Pink, E. G., Central Electric Light Station, Fleet-st, Dublin; and 4, Charlemont-avenue, Kingstown
Piper, E. Jesse (Messrs. Sharp and Kent), 34, Victoria-st, London, S.W.
Pitman, Maurice, Messrs. Wm. Curtis & Sons, Middle Abbey-st, Dublin
Polyblank, Charles, 47, Wind-st, Swansea
Poole, T. G., 4, Whitbread-rd, Brockley, London, S.E.
Pope, Edwyn L., Chelsea Electricity Supply Company, Limited, 91, Manor-st, Chelsea, London, S.W.
Pope, Philip C., Messrs. J. E. Spagnoletti & Crookes, St. James' Hall, Barnsley
Popham, W. V. M., 13, Victoria-st, London, S.W.
Poore, Graydon, 47, Cannon-st, London, E.C.
Potter, Douglas, 112, Chetwynd-rd, Dartmouth Park, London, N.W.
Potter, William, Messrs. H. F. Joel & Co, 31, Wilson-st, London, E.C.
Powell, Charles, Chatham, Rochester and District Electric Light Company, 22, High-st, Chatham
Poynton, W. A., 4, Salisbury-road, Dalston, London, N.E.
Preece, A. H., 39, Victoria-st, London, S.W.
Preece, W. L., Midland Railway Company, Derby
Preller, Dr. Chas. S. du Riche, M.A., 18, Margaret-st, Cavendish-sq, London, W.
Pressland, Wm. Thos., 11, Delahay-st, S.W., and 38, Perran-rd, Tulse Hill, S.E., London
Prestland, Walter, jun., 122, Douglas-st, Deptford, S.E.; and 43, King's-rd, Camden Town, N.W., London
Price, H. B., Chelmsford Electric Light Company's Central Station, Arc Works, Chelmsford
Proctor, C. Faraday, Edison and Swan United Electric Light Company, Limited, Ponder's End, Middlesex
Proctor, H. Faraday, Central Electric Light Station, Temple Back, Bristol
Proctor, W. J., Duke-st, Nuneaton
Pryke, Wm. R., London and Lancashire Electric and General Engineering Company, Ltd., Kingsland-green, Dalston, London, N.E.
Pullen, A. E., Town Hall, Huddersfield
Putland, E. E., 13, Buckingham-st, Strand, Lond n, W.C.
Pynegar, Henry, 5, Dowgate-hill, London, E.C.
Pyne, H. S., 24, Highfield-crescent, Rockferry, Cheshire
Quicke, C. F., c/o Okonite Company, Limited, 38 Finsbury-pavement, London, E.C.
Radcliff, William, St. Helier's, Torquay
Rance, John, jun., Bournemouth and District Electric Supply Company, Limited, 22, Observer-chmbrs, Bournemouth
Randall, J., Town Hall, Portsmouth (To the Corporation)
Ranken, A. W., Corporation Central Station, Temple Back, and 21, Clyde-rd, Redlands, Bristol
Raphael, F. C., Elmstead, Broadhurst-gdns, London, W.
Ravenshaw, H. W. (Messrs. W. T. Goolden & Co), Woodfield Works, Harrow-rd, London, W.
Raworth, John S. (Brush Electrical Engineering Company, Limited), Belvedere-rd, Lambeth, S.E., and 24, Kirkstall-rd, Streatham, S.W., London
Rawson, F. L., 88, Queen Victoria-st, E.C., and 3, Kensington-court, Kensington, W., London
Rea, P. J., Crystal Palace District Electric Light Company, Limited, Springfield Works, Upper Sydenham, London, S.E.
Ready, G. W., Electric Light Department, Royal Courts of Justice, London, W.C.
Rennie, D. B. (Graham & Morton), King-st, Stirling
Rennie, J., M.I.E.E., 10, Rodney-ter, Lower Richmond-rd, Putney, London, S.W.
Renshaw (W. R.) & Co, Queen Anne's-mans London, S.W.
Renwick, James, 58, Olinda-road, Stamford Hill, London, N.
Rew, G. H., Pembury, Maberley-rd, Upper Norwood, London, S.E.
Rhodes, A., Providence Foundry, Stanningley, Leeds
Richardson, A. E., Dorking, Surrey
Rider, J. H., Town Hall, Bolton
Ridley, H. W., 100, Bennerley-rd, Wandsworth, London, S.W.
Riley, Prof. J. T., D.Sc., Bradford Technical College, Bradford
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Ritchie, Robert O. (Electric Construction Co, Limited), Queen-street-chmbrs, Queen-st, London, E.C.
Ritter, J. E., Limavady Power and Light Works, Largy Mills, Limavady
Robinson, Alex. H., Oakhill Park, Liverpool
Robinson, C. Norman, 37, College-hill, Dublin
Robinson, Henry, St. Pancras Vestry, London, N.W.
Robinson, W. H., Orient House, Terrace-rd, Upton, London, E.
Robinson, William, 54, Hemberton-rd, Clapham, London, S.W.

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Robinson, Prof. William, University College, Nottingham
Rock, Thomas, 364, Gray's-inn-rd, London, W.C.
Rogers, H. J., 308, High-st, Watford
Ronalds, B., 71, Francis-rd, Edgbaston, Birmingham
Rorke, Thos. Joseph, 17A, Great George-st, Westminster, London, S.W.
Ross, J. (Messrs. Arthur & Co), William-st, Anderston, Glasgow
Rossiter, A. E., 45, Parliament Hill-rd, Hampstead, London, N.W.
Rousseau, Emile, 17, Westdown-rd, Catford Bridge, London, S.E.
Routledge, W., 49, Trinity-sq, London, S.E.
Rowlandson, Wm., 67, Lord-st, Liverpool
Rudd, J. A., 128, Hope-st, Glasgow
Russell, Earl, 11, Queen Victoria-st, London, E.C.; and Amberley Cottage, Maidenhead, Berks.
Rushworth, A., c/o Ernest Scott & Mountain, Limited, Close Works, Newcastle-on-Tyne
Russell, C. N., London and Lancashire Electric and General Company, Limited, Kingsland-grn, Dalston, London, N.E.
Russell, John A., Digby House, Hammersmith, London, W.
Russell, N. Scott, 39, Coleman-st, London, E.C.
Russell, T., West Calder
Rutherfoord, B., Darver Castle, Castle Bellington, co. Louth, Ireland
Ryan, J., M.A., D.Sc., University College, Bristol
Sadler, Hastings V., 84, Burlington-st, Manchester
Salisbury-Jones, F. W., Waterhouse Electrical Manufacturing Company, Limited, 67, Southwark Bridge-rd, London, S.E.
Sanders, A. G., Messrs. B. Verity & Sons, 29, Prince's-st and 53, Bees-st, Moss Side, Manchester
Sanderson, George, 203, Adelaide-rd, South Hampstead, London, N.W.
Sankey, H. R., Capt. R.E., Ferry Works, Thames Ditton
Saunderson, L., 10, Vesci-ter, Kingstown, Dublin
Savill, Arthur G., Boleyns, Braintree, Essex
Sayer, G. H., St. James's Gate Brewery, 52, Upper Leeson-st, Dublin
Sayer, John, Electrical Department, Midland Railway Company, Derby
Sayer, John S., 25, St. Leonard's-ter, Chelsea, London, S.W.
Schmidt, F. T., 9, Clarendon-rd, Bradford
Schneider, Adolph, B.A., c/o Messrs. W. T. Goolden & Co, Woodfield Works, Harrow-rd, London, W.
Schramm, Louis (Messrs. Wyand & Sons), 15, Lower Grosvenor-pl, London, S.W.
Schultz, George (Notting Hill Electric Lighting Company, Limited), Bulmer-pl, Notting Hill-gate, London, W.
Scott, Allen F., 41, Piccadilly, Bradford
Scott, Ernest, c/o Brush Electrical Engineering Company, Limited, Falcon Works, Loughborough
Specialist in Electric Mining Work
Scott, Ernest (Ernest Scott & Mountain, Ltd.) Close Works, Newcastle-upon-Tyne
Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.
Scott (James) & Co, 9, Tottenham-st, London, W.
Scott & Sellar, Aberdeen
Scott, W. H. (Laurence, Scott & Co, Limited), Gothic Works, King-st, Norwich
Scott, J. C., M.A., 14, North-rd, Surbiton
Scott, John, 134 to 140, Douglas-st, and 201, Byres-rd, Dowanhill, Partick, Glasgow
Sclater, Arthur W., 182, Oxford-st, London, W.
Scrutton, Percy C., 24, Queen Victoria-st, London, E.C.
Seaman, Arthur G., Preston House, Surbiton-rd, Surbiton
Seaton, W. Sharpey, 57½, Old Broad-st, London, E.C.
Sellon, R. P. (Brush Electrical Engineering Company, Limited), 112, Belvedere-rd, Lambeth, London, S.E.
Sedgwick, F. W., Jesmond House, Epsom
Sevenoaks, W., Acre House, Windsor
Sharp, Sydney, Connaught-mansions, 34, Victoria-st, London, S.W.
Sheffield, F., 29, Whalley-rd, Accrington
Shepherd, A. L., Planet Electrical Engineering Company, Limited, 4, Victoria-mansions, Victoria-st, Westminster, London, S.W.
Shepherd & Watney, 71, Albion-st, Leeds
Shipton, F. H. E., Orchard-st, Wandsworth, London, S.W.
Shoolbred, J. N., B.A., M.I.C.E., 47, Victoria-st, London, W.
Shorrock, L., Low Hill, Darwen, Lancs.
Siddalls, J., Town Hall, Tiverton
Siemens, Alexander, 12, Queen Anne's-gate, Westminster, London, S.W. (President of the Institution of Electrical Engineers for 1894)
SIEMENS BROS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**
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Simons, H. F., 38, Princes-sq, Bayswater, London, W.
Simpson, E. L., 11, Lower Parkfields, Putney, London, S.W.
Sinclair, Alex., 7, Uplands-cres, Swansea
Sisling, W. B., Gothic Works, Norwich and Hamilton-drive, The Park, Nottingham
Skilton, S. J., Wardrobe-chmbrs, Queen Victoria-st, London, E.C.
Slater, Alex., Public Library, Edinburgh
Slater, Ernest, 19, Great George-st, London, S.W.
Slatter, Alfred, 7, Ridgmount-st, Store-st, London, W.C.
Sleigh, J. P., Finsbury Technical College, Leonard-st, London, E.C.
SLINGO & BROOKER, 65, Chelsham-rd, Clapham, London, S.W.
Smeeton & Page, 63, Queen Victoria-st, London E.C.
Smillie, J. A., 106, Caledonian-rd, London, N.
Smith, C. E., Messrs. Christy Bros., Broomfield-rd, Chelmsford

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Smith. E. W., 63, College-st, Chelsea, London, S.W.
Smith, F. W., Waterside, Knaresborough, Yorks.
Smith, H. Whitmy, Towerfield, Northampton
Smith, Henry, 2, Curtain-rd, London, E.C.
Smith, M. Holroyd, 161, Trinity-rd, Upper Tooting, London, S.W.
Smith, Prof. Robert H., Mason Science College, and 124, Hagley-rd, Birmingham
Smith, R. A., Ordsal Station Electrical Works, Salford, Manchester
Smith, Thomas, 46, South Hill-park, Hampstead, London, N.W.
Smith, W. S., B. Sc., 13, Courtfield-rd, South Kensington, London, S.W.
Smith, Wm. F., 7, Blenheim-st, London, W.
Smyth, A. M., Central Electric Light Station, Richmond, Surrey
Smythe, Carrington R. G., c/o Messrs J. H. Holmes & Co, 27, Bothwell-st, and 5, Doune-quadrant, Kelvinside, Glasgow
SNELL, ALBION T., Suffolk House, Cannon-st, E.C., and Brightside, Salusbury-rd, Brondesbury Park, N.W., London. (Mining)
Snell, J. F. C., Albert Electric Lighting Company, Limited, Surrey House, Laurence Pountney-hill, Cannon-st, London, E.C.
Snowdon, R., Lake Vyrnwy, near Oswestry
Soames, A. (Nalder Bros & Co), 16, Red Lion-st, Clerkenwell, London, E.C.
Somers, R. M., 15, Brudenell-rd, Hyde Park, Leeds
Sotheby & Ridout, 124, Regent-st, London, W.
Southam, A. D., St. Paul's-bldgs, 28, 29 & 30, Paternoster-row, London, E.C.
Southey, H. E., 37, Crouch End-hill, London, N.
Sowter, William J., County Lunatic Asylum, Lancaster (Engineer-in-charge)
SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.
Spagnoletti, Hylton, Swansea
Sparks, Charles Pratt, 27, Charterhouse-sq, E.C., and 5, Carmalt-gdns, Richmond-rd, Putney, S.W., London
Spence, Wilfrid L., Assoc.M.Inst.C.E., The Elms, Seymour-grove, Manchester, S.W.
Stallibrass, Edward, c/o W. Sharpey Seaton, 57½, Old Broad-st, London, E.C.
STATTER (J. G.) & CO, Ltd, 68, Victoria-st, S.W., and Millwall, E., London. (Telegrams: *Statter London;* Telephone No. *3138*) **See Advt., p. 471**
Staveley, A. W., 87, Hinckley-rd, and Faraday Works, Leicester
Stevenson, Chas., F.R.S., 84, George-st, Edinburgh
Stevenson, H., Hove Electric Lighting Company, Limited, Hove
Stewart, A. W., The Crescent, Dalmuir, near Glasgow
Stewart, J. E., Corporation Electric Lighting Station, Full-st, and Melrose, Trowls-lane, Derby
Stewart, S., Greenock Central Electric Light Station, Prospect Hill, Greenock
Still, Percy, Chelsea Electricity Supply Company, Limited, Draycott-pl, Chelsea, London, S.W.
Straube, Albert A. L., 12, Queen Anne's-gate, Westminster, London, S.W.
Stockley, H. R., Calder Ironworks, Coatbridge, N.B.
Stockman & Doyle, 3, Poet's-corner, Westminster, London, S.W.
Stotherd, L. H. K., 23, Wellington-rd, Charlton, London, S.E.
Stott & Sons, 60, Haworth's-bldgs, 5, Cross-st, Manchester
Stuart-Menteath, Edward Thorold, Hampden Club, Phœnix-st, St. Pancras, London, N.W.
SUGDEN, JAMES, 3, Belmont-villas, Rye-rd, Newlands, Peckham, London, S.E.
Sumpner, W. E., D.Sc., Battersea Polytechnic, Battersea, London, S.W.
Suter, F., 66, Berners-st, London, W.
Suter, Sidney J., 22, Bickerton-rd, Junction-rd, London, N.W.
Swan, Joseph W., Lauriston, Bromley, Kent.
SWINBURNE, JAMES, 4, Hatherley-rd, Kew Gardens, London, S.W.
Swinton, A. A. Campbell, 66, Victoria-st, London, S.W.
Talbot, Ernest, 5, Victoria-st, London, S.W.
Talbot, H., Nottingham (To the Corporation)
Tallis, John Fox, The Firs, Ebbw Vale, Mon.
Tasker, Ernest A., 4, Dean-st, St. Paul's, Bristol
Tasker, John, Crooke's House, Sheffield
Tasker, W. Howard, 12, Pembroke-rd, Kensington, London, W.
Tatham, Sydney B., 16, Davies-st, Berkeley-sq, London, W.
Tatlow, W., 7, Belgrave-sq W., Monkstown, Dublin
Tayler Smith, T., 53, South Molton-st, London, W.
Taylor, A. Lester, Prudential-bldgs, 36, Dale-st, Liverpool
Taylor, A. M., Conduit Lodge, Blackheath Park, London, S.E.
Taylor, Chas. Purcell, c/o Mrs. Robertson, 82, High-st, Dundee
Taylor, Frederic H., "Kenwyn," 14, Darenth-rd, Stamford Hill, London, N.
Taylor, G. Crosland, Britannia Telegraph Works, Helsby, near Warrington
Taylor, G. E., Southampton Harbour Board, Southampton
Taylor, H. A., 25, Collingdon-rd, South Kensington, London, S.W.
TAYLOR, W. F., Boswell Court, Croydon
Terry, Stephen H. A. (Bumsted & Chandler), 17, Victoria-st, London, S.W.
Thomas-Davies, G., Tylagwyn, Pontllanfraith, Newport, Mon.
THOMPSON, NORCLIFFE GEORGE, 13, Victoria-st, London, S.W. **See Advt., p. 13**
Thompson, Prof. Silvanus P., B.A., D.Sc., Morland, Chislett-rd, West Hampstead, London, N.W.
Thompson, R., 24, Highfield-crescent, Rockferry, Chester
Thompson, R. D., Boarshaw, Middleton, near Manchester
Thompson, W., Gas Department, Municipal Offices, Victoria-st, Blackburn
Thomson, C. S., M.Sc., 98, Amity-grove, Cottenham Park, Wimbledon, London, S.W.
Thomson, Jocelyn H., 18, Draycott-pl, London, S.W.
Thomson, Prof. J. J., Cambridge University

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Thursfield, Francis, B.A., Electric Lighting Station, Aqueduct-st, Burnley
Thwaite, B. H., 95, Finsbury-pavement, London, E.C.
Tidd, E. George, Messrs. Paterson & Cooper, 137, West Regent-st, Glasgow
Tittensor, Walter H., Dudhope Crescent-rd, Dundee (To the Borough)
Todd, F. L., Occold Rectory, Eye, Suffolk
Todd, John, 82, Turnmill-st, London, E.C.
Tonge, J. H., National Electric Supply Company, 119, Fishergate, Preston, Lancs.
Tooker, J. J., 1, Keppel-ter, Stoke, Devonport
Treherne, Hugh, 5, Bedford-gdns, Kensington, London, W.
Treuenfeld, R. von Fischer, The Glen, Endlesham-rd, Balham, London, S.W.
Trevett, B., 122, Mallinson-rd, Wandsworth Common, London, S.W.
Trotter, A. P., 28, Victoria-st, S.W., and 1, 2, and 3, Salisbury-ct, Fleet-st, E.C., London
Trotter, Howard B., 176, Adelaide-rd, Hampstead, London, N.W.
TUNZELMANN, G. W. DE, Electrical and General Engineering College, Penywern House, 2 and 4, Penywern-rd, Earl's-ct, London, S.W. **See Advt., p. 461**
Tumber, E. J., Ford-Lloyd Manufacturing Company, Limited, 2-8, Mount-pleasant, Clerkenwell, London, W.C.
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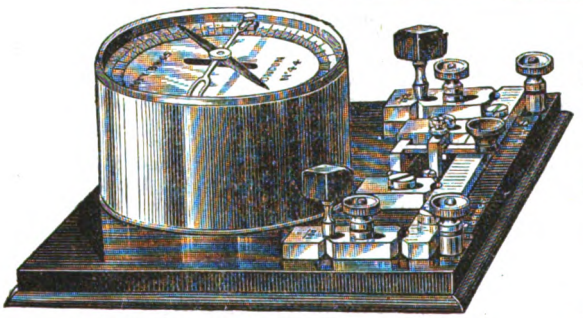

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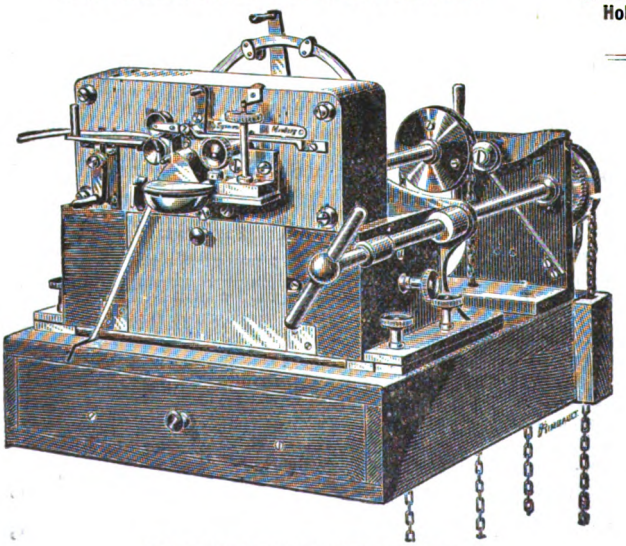

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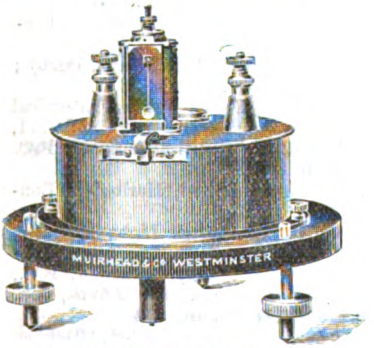

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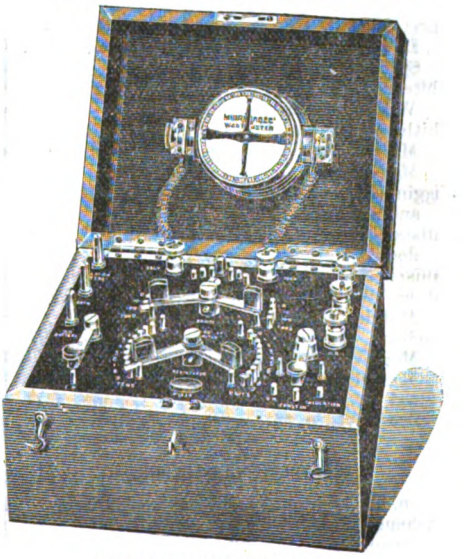

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Electrical Standardizing, Testing & Training Institution, Charing Cross-road, London, W.C.

Institute of Chemical Technology and Analytical Laboratory, Hackins Hey, Dale-st, Liverpool.

Liverpool Research Laboratory, 18, Albion-st, Everton, Liverpool

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DELAWARE HARD FIBRE COMPANY, Wilmington, Del., U.S.A.; and 15, Long-lane, London, E.C. **See Advt., p. 576**

DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocers' Hall-ct, Poultry, London, E.C. **See Advt., p. 11**

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GLOVER (W. T.) & CO, Salford, Manchester; and 39, Victoria-st, London, S.W. **See Advt., p. 40**

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LAURENCE, SCOTT & CO, Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**
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LUNDBERG, A. P., Bradbury Electrical Works, Bradbury-st, Kingsland, London, N. **See Advt., p. 619**
McLaren, J., 34, St. Andrew-sq, Edinburgh
Miller & Woods, 2, Gray's Inn-rd, Holborn, London, W.C.
MUIRHEAD & CO, 2, Princes-st, Great George-st, London, S.W. **See Advt., p. 521**
Robertson & Co, 234, Sauchiehall-st, Glasgow
Sherborne Electric Installation, Sherborne, Dorset
TAYLOR, TUNNICLIFF & CO, Eastwood, Hanley. **See Advt., p. 485**
VERITY (B.) & SONS, 31 and 32, King-st, Covent Garden, W.C., and 137, Regent-st, W., London; Plume Works, Aston, Birmingham; and 29, Princes-st, Manchester
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ELECTRICAL SUNDRIESMEN.

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AUTOMATIC STANDARD SCREW COMPANY, Halifax. **See Advts., pp. 611 and 634**
Baxendale & Co, Miller-st, Manchester; and Edinburgh
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DELAWARE HARD FIBRE COMPANY, Wilmington, Del, U.S,A., and 15, Long-lane, London, E.C. **See Advt., p. 576**
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EVERED & CO, Limited, 27-31, Drury-lane, W.C., 143, High-st, Shoreditch, E., and 50, Holborn-viaduct, E.C., London; and Surrey Works, Smethwick. **See Advt., p. 38**
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GLOVER (W. T.) & CO, Salford, Manchester, and Albany-bldgs, 39, Victoria-st, London, S.W. **See Advt., p. 40.**
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Lewis, William T., 10, Chryssell-rd, Brixton, London, S.W.
Lundberg, A. P., Bradbury Electrical Works, Bradbury-st, Kingsland, London, N. **See Advt., p. 619**
Martin, W. W., Worcester-cross, Kidderminster
Paterson & Cooper, European Works, Pownall-rd, Dalston, N.E., and 68, Victoria-st, S.W., London. **See Advt., p. 39**
Standard Time Recording Company, Limited, 39, Victoria-st, London, S.W.
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Butler (H. W.) & Co, 108, London-wall, London, E.C.
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Clerkenwell Electrical Stores, 50, Myddleton-st, London, E.C.
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Cox-Walkers, North-Eastern Electric Works, Darlington
Cutting & Co, Parliament Works, Derby
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Wills (C.) & Sons, Seamoor-rd, West Bournemouth
Woodhead, Thos., Prudential-bldgs, Park-row, Leeds
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(*See also* **Casings, Wood.**)

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Andersen, F. V., 14, Westdown-rd, Catford, London, S.E.
Andersen, J. M., 2, Lancaster-pl, Strand, London, W.C.
Anderson, Prof. Alex., Queen's College, Galway
Anderson, Christopher, Lane House, Jack-lane, Hunslet, Leeds
Anderson, S. L., 123, Upper Hanover-st, Sheffield
Andreoli, E., 18, Somerleyton-rd, Brixton, London, S.W.
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Ashmore, H. L., National Telephone Co, Oxford-court, Cannon-st, London, E.C.
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Atkinson, Hans Edwin B., 82, Seymour-st, Hyde Park, London, W.
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Bonney, S. R., 25, Avenue-rd, Lewisham, London, S.E.
Booth, Henry, 80, Linnaeus-st, Hull
Bottomley, J. T., M.A., D.Sc., F.R.S.E., F.C.S., The University, Glasgow
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Boys, C. Vernon, Royal College of Science, Exhibition-rd, South Kensington, London, S.W.
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Brown, John, Edenderry House, Shaws Bridge, Belfast
Brown, Richard, 43, Milner-st, Preston, Lancs
Brown, W. A. M., 13, Ash-grove, Victoria-rd, Headingley, Leeds
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Chapman, H., Morley, Lancs.
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Chitty, Henry, 5, Bolton-gdns, Chiswick, London, W.
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Chrystal, Prof. G., F.R.S., 5, Belgrave-cres, Edinburgh
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Cooper, W. R., M.A., Woodlands, Clapham Park, London, S.W.
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Copp, W. L., Watchet, Somerset
Cormack, J. D., Yorkshire College, Leeds
Cornell, Wm., 67, May-st, Fulham, London, S.W.
Cornish, V. K., c/o Eastern Telegraph Co, 50, Old Broad-st, London, E.C.
Cossor, Alfred C., 67, Farringdon-rd, London, E.C.
Cotsworth, W. J., 138, Wilmslow-rd, Fallowfield, Manchester
Cotton, R., Claybury, Woodford Bridge, Essex

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Cowie, Capt. A. H., R.E., 7, Redford-circus, Exeter
Cox, Arthur Wm., London & South Western Railway Co, Winchester
Cox, F. W. Pope, Templeton-mansions, Earl's Court, London, S.W.
Cox, Harry Wm. Chas, 51, Cricketfield-rd, Lower Clapton, London, N.E.
Cox, W. B., Eastwood House, March, Cambridgeshire
Crampton, Thomas P. C., 12, Swinton-st, Gray's Inn-rd, London, W.C.
Crawford, Tyson (Messrs. Dollond and Co), 35, Ludgate-hill, and 62, Old Broad-st, London, E.C.
Crawley, C. W. S., 44, Castleton-rd, West Kensington, London, W.
Crawter, Frank W., 35, St. George-sq, Regent's Park, London, N.W.
Creak, Capt. Ettrick W., R.N., F.R.S., 36, Kidbrooke Park-road, Blackheath, London, S.E.
Croft, W. J., 9, Percy-st, Cleveland-rd, Crumpsall, Manchester
Crofton, Edward, 45, West Cromwell-rd, London, S.W.
Cromartie, D. B., M.I.E.E., Town and County Club, Bedford
Crompton, R. E. B., Messrs. Crompton & Co, Limited, Mansion House-bldgs, Queen Victoria-st, London, E.C.
Cross, W. E., Egremont, Laurie Park-rd, Sydenham, London, S.E.
Crouch, A. P., India Rubber, Gutta Percha and Telegraph Works Company, Silvertown, Essex
Crowley, Richard Joseph, Harbour-row, Queenstown, co. Cork
Crowther, John A., 96, Bignor-st, Cheetham, Manchester
Crum-Brown, Prof Alex. M.D., The University, Edinburgh
Cuff, J. C., 25, College Green, Bristol
Curtis, E. S., c/o P. & O. Steam Navigation Co, Leadenhall-st, London, E.C.
Cunynghame, H. H. S., Hurlingham Lodge, Fulham, S.W., and 2, Paper-bldgs, Temple, E.C., London
Dalby, W., 4, Everdon-pl, Main-st, Sparkbrook, Birmingham
Dale, E. J., 10, Cursitor-st, London, E.C.
Dalton, Samuel Thomas, Bradford Corporation Electric Works, Bradford
Daubeny, E. C., 6, Grosvenor-hill, Wimbledon
Davey, William J., 161, Huddleston-rd, Tufnell-Park, London, N.
Davidson, Archie, 266, Trinity-rd, Wandsworth Common, London, S.W.
Davies, Charles, 53, Dorset-st, Baker-st, London, W.
Davies, David, Oriental Waterproofing Company, Wallis-rd, Hackney Wick, London, N.E.
Davis, A., 1, Mitcham-rd, Tooting Junction, London, S.W.
Davis, Albert L., Endoby, Guernsey
Davis, Edward P., 149, Finchley-rd, London, N.
Davis, H., 21 Kidderminster-rd, Croydon
Davis, T., 20, Alexandra-rd, Hill, Southampton
Dawbarn, R. A., 54, Cromford-rd, Wandsworth, London, S.W.
Dell, Holland, The Hermitage, 51, St. James-rd, Upper Tooting, London, S.W.
Dering, Geo. E., Lockleys, Welwyn, Herts.
Devey, Arthur Chas., 6, Mincing-lane, London, E.C.
Dickinson, W., Northcote-villa, Spring Grove, Isleworth
Dieselhorst, Wilhelm (Siemens Bros & Co), Woolwich, Kent
Dingle, W. H., 13, Hindon-st, Pimlico, London, S.W.
D'Odiardi, E. S., 43, Cornwall-gdns, London, S.W.
Dolby, E. R., 8, Princes-st, Westminster, London, S.W.
Donne, F. M., 3, Gloucester-ter, Hyde Park, London, W.
DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocers' Hall-ct, Poultry, London, E.C. **See Advt., p. 11**
Doubleday, Villeroy C., Electric Cycle Syndicate, Limited, 37, Walbrook, London, E.C.
Doughty, E., Foxhall-rd, The Forest, Nottingham
Douglass, Archibald, Wardrobe-chmbrs, Queen Victoria-st, London, E.C.
Dowson, J. Emerson, 3, Great Queen-st, Westminster, London, S.W.
Drew, J. W., 20, St. Petersburg-pl, Bayswater, London, W.
Drummond, H. H. J. W., 20, Draycott-pl, Chelsea, London, S.W.
Drummond, R. H. Tudor, 49, Norroy-rd, Putney, London, S.W.
Dumbrell, J. A., 24, Park Hill-gdns, Sydenham, London, S.E.
Duncan, R., Crowthorne, Berks.
Dunkley, G. W., Ditcham Park, Petersfield
Durnford, Chas. W., 8, The Avenue, Blackheath, London, S.E.
Duthy, J. W. B., Cronberg, Arterberry-rd, Wimbledon
Dykes, A. H., 23, Holmesdale-rd, Bromley, Kent
Eagar, H. T., 31, St. Dunstan-st, Canterbury
Eccles, E. S., 3, Holyrood-ter, The Hoe, Plymouth
Eden, A., Engineer-in-Chief's Department, General Post Office, London, E.C.
Edmunds, Henry, Messrs. W. T. Glover & Co., Salford, Manchester; and 39, Victoria-st, London, S.W.
Eggers, F. T., Electrical Company, Limited, 122-124, Charing Cross-rd, London, W.C.
Eliott, J. T., Tokenbury, Liskeard
Elliot, Robert Thomas, 200, Wellington-st, Leeds
Ellis, W., F.R.A.S., Royal Observatory, and 1, Hyde Vale-villas, Greenwich, London, S.E.
Ely, Fourd, India Rubber, Gutta Percha and Telegraph Works Company, Limited, Silvertown, London, E.
Epstein, L., Epstein Electric Accumulator Company, Limited, 21A, Blyth-rd, Hammersmith, London, W.
Erskine-Murray, J., B.Sc., 40, Montgomerie-drive, Glasgow

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Evans, Mortimer, Savile Club, Piccadilly, London, W.
Ewing, Prof. J. A.,, M.A., B.Sc., F.R.S., F.R.S.E., The University, Cambridge
Fabris, V., 18, Rathbone-pl, London, W.
Fahie, Angelo, 9, Westland-row, Dublin
Fairall, Geo. W., 34, Ann-st, Tettenhall-rd, Wolverhampton
Fanshawe, Harry, Thoralby, Fortune Gate, Harlesden, London, N.W.
Farquharson, J., Woodlands Cottage, High-st, Acton, London, W.
Fell, A. L. C., 2, Staple Inn, Holborn, London, W.C.
Ferguson, Russell Forrester, 1 and 2, Great Winchester-st, London, E.C.
Fergusson, O., 190, Eglinton-rd, Woolwich Kent
Fergusson, Russell J., The Corporation Electric Lighting Station, Brighton
Ferranti, Sebastian Ziani de, 27, Charterhouse-sq, London, E.C.
FERRANTI, S. Z. DE, Limited, St. Benét-chmbrs, Fenchurch-st, and 27, Charterhouse-sq, London, E.C. **See Advt. p. 594**
Festing, Major-Gen. G. R., R.E., F.R.S., The Residences, South Kensington, London, S.W.
Field, Algernon Sidney, Algernon Lodge, Worple-rd, Wimbledon
Field, H., 12, London-st, London, E.C.
Fisher, Henry, 21, Arthur-st, London, W.C.
Fisher, W. Clark, 3, Horbury-cres, Notting Hill Gate, London, W.
Fitch, Charles J., The Braes, 2, Ouseley-rd, Wandsworth Common, London, S.W.
FitzGerald, Desmond G., 94, Loughborough-rd, and 75, Akerman-rd, Brixton, London, S.W.
Fleetwood, Chas. Henry, 10, Edwardes-sq, Kensington, London, W.
Fleming, Prof. J. A., M.A., D.Sc., 100, Victoria-st, S.W., University College, N.W., and 9, Clifton-gdns, Maida-hill, London
Fletcher, B. M., 7, Victoria-st, London, S.W.
Fletcher, F. C. S., Warrington
Fletcher, R. H., St. Mary's-chambers, Cardiff
Flood, W. H., c/o Marine Engineers' Institute, Sunderland
Flower, J. W., jun., 59, Hartham-rd, Camden-rd, London, N.W.
Forde, H. C., 4, Great Winchester-st, London, E.C.
Forster, R., Messrs. J. Sunderland & Co., Victor Electrical Works, Halifax
Foster, H. F., 60, Cornwall-rd, Westbourne Park, London, W.
Foster, Prof. G. Carey, 18, Daleham-gdns, South Hampstead, and University College, London, N.W.
Fournier, E. E., Royal College of Science, Dublin
Fowler, J., 9, Heathville-rd, Gloucester
Francis, F. H., 8A, St. Aldate's, Oxford
Frederison, M., 8, Regent-st, London, W.
French, Archibald John, 64, Anthony-st, Commercial-rd, London, E.
Froggatt, Thomas, jun., 55, Thomas-st, Kennington, London, S.E.
Fulton, T. Crichton, 74, Buchanan-st, Glasgow
Fyfe, J., 25, Garlick Hill, London, E.C.
Galgey, J. M., 2, Clifton-ter, Cork
Garford, J., 3, Vernon-chmbrs, Southampton-row, London, W.C.
Garnett, Prof. W., London County Council, Spring Gardens, London, S.W.
Garrard, W. C., 10, Hearne-rd, Chiswick, London, W.
Garratt, H. A., University College, Bristol
Garratt, J. H., Acton Hill Electrical Works, Acton Hill, London, W.
Gay, Albert, Islington Vestry, London, N.
Gee, W. W. Haldane, F.C.S., Owens College, Manchester
Gibbon, James, Haseley Iron Works, Haseley, Tetsworth, Oxfordshire
Gibbs, John Dixon, Conservative Club, St. James's-st, London, S.W.
Gilbert, John J., 72, Cambridge-st, The Crescent, Birmingham
Gillies, Thomas, 6, Goulton-rd, Lower Clapton, London, N.E.
Gimingham, Edward, Edison and Swan United Electric Company, Ponders End, Middlesex
Glynn, H. Justice, Prospect Villa, Mere, Wilts.
Godfrey, W. B., 23, St. Swithin's-lane, London, E.C.
Goodare, —, Messrs. R. Evans & Co, Haydock, St. Helens
Gosling, L. F., 21, Selwood-ter, London, S.W.
Gott, J., Commercial Cable Company, 55 and 56, Bishopsgate-st Within, London, E.C. ; and 6, Lorna-rd, Hove, Sussex
Gough, T. J., 33, Mosley-st ; and Palace of Varieties, Oxford-rd, Manchester
Graham, R. W., Burley Village, Leeds
Graham, W. J., 78, Woodland-ter, Charlton, Kent
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Gray, William E., India Rubber, Gutta Percha, and Telegraph Works Company, Limited, Silvertown, London, E.
Green, Bernard, 1, Elm Tree-ter, Cockermouth
Green, G. W , Messrs. Muirhead & Co, 2, Princes-st, Westminster, London, S.W.
Green, L. M., Bryn House, Dolgelly, North Wales
Green, R., Victoria-rd, Wargrave, near Twyford, Berks
Green, S. A., 6, Edith-rd, Chandos-rd, Stratford, London, E.
Greener, J. H., 15, Walbrook, London, E.C.
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Griffiths, E. H., 12, Park-side, Cambridge
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Grittan, Joseph, 97, Highbury-quadrant, London, N.
Grove, E. P., 5, South-parade, Chelsea, London, S.W.
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Hagues, Tom, Rotherwood Iron and Steel Company, Sheffield
Halford, Thomas Ernest, 11, Furnival-st, Holborn, London, E.C.
Hall, E. A. (Walker Bros), Pagefield Iron Works, Wigan
Hall, J. P., Gorse Bank, Windsor-rd, Oldham, Lancs.
Hallows, F., 37, Stockwell Park-cres, London, S.W.
Hammond, Robert, 117, Bishopsgate-st, London, E.C.
Hancock, Walter, 10, Upper Chadwell-st, Myddelton-sq, London, E.C.
Hancocks, Stuart, Mortlock, Broomy Hill, Hereford
Hanson, Albert, Thornleigh, Apperley Bridge, Leeds
Hanson, Luther, Mayfield Cottage, Marlpool-lane, Kidderminster
Harcourt, Thomas, Ford's Water, Zeal, Wilts.
Harrap, T., 8, Crescent-st, Park-lane, Leeds
Harris, A., 4, Crouch-hill, London, N.
Harris, W., 29, Lockington-rd, Battersea Park-rd, London, S.W.
Harrison, Hugh E., Faraday House, Charing Cross-rd, London, S.W.
Hart, Francis G., 28, Victoria-street, London, S.W.
Hart, James H., 11, Glycena-rd, Lavender Hill, London, S.W.
Harvey, G., 87, Dean-st, Soho, London, W.C.
Harvey, Henry S., Percy Villa, Maryon-rd, Charlton, Kent
Hasdell, H. D., Post Office Savings Bank, Queen Victoria-st, London, E.C.
Haslam, T. J., Altadore, Glenageary, Kingstown, Co. Dublin
Hawes, F. B. O., 118, East Ferry-rd, Millwall, London, E.
Hawtayne, W. C. C., 3, Prince's-mansions, Victoria-st, London, S.W.
Haycraft, H. C., City and Guilds of London Institute, Exhibition-rd, South Kensington, London, S.W.
Headech, E. T., 61, Falmouth-rd, New Kent-rd, London, S.E.
Heaton, Prof. W. H., M.A., University College, Nottingham
Henderson, James B., B.Sc., Glasgow University, Glasgow
Herbert, E. A., 7, Humber-rd, Westcombe Park, London, S.E.
Herbert, Ernest G., Aysgarth, Calverly Park Gardens, Tunbridge Wells
Herbert, Geo., 46, Brooksby-st, Barnsbury, London, N.
Herron, G. F., 14, De Vere-gdns, Kensington, London, W.
Heys, William Edwin, 70, Market-st, Manchester
Heywood, S. H., 12, Brazenose-st, Manchester
Hibberd, S., 40, Southey-st, Bootle
Hibbins, Wm. Geo., Baxter-gate, Loughborough, Leicestershire
Hill, A. W., Edison & Swan United Electric Light Company, Limited, Ponders End, London, N.
Hill-Hartland, W. H., 723, Grimesthorpe-rd, Sheffield
Hill, T. C., 84, Hereford-rd, Bayswater, London, W.
Hillard, Geo., 47, Forest-lane, Stratford, London, E.
Hirst Hugo, 71, Queen Victoria-st, London, E.C.
Hodges, J. Percy, 10, Cholmley-villas, Long Ditton, Surrey
Hollick, W. D., 602, Commercial-rd, London, E.
Hollis, W., 308, Wick-rd, Victoria Park, London, E.
Holmes, Ernest, c/o Messrs. Siemens Bros & Co, Limited, Woolwich
Hope-Jones, R., 55 and 57, Argyle-street, Birkenhead
Hopwood, James, 11A, Cargil-rd, Earlsfield, London, S.W.
Horn, T. L., c/o Messrs. Siemens Bros & Co, Limited, Woolwich, London, S.E.
Housman, Robert Holden 61, Marloes-rd, Kensington, London, W.
Howard, Dr. James L., 20, Oxford-rd, Waterloo, Liverpool
Howell, J. C., 24, Queen Victoria-st, London, E.C.; and Llanelly, South Wales
Howes, A. J., 73, St. Stephen's-rd, Upton Park, London, E.
Hume, G. H., The Woodlands, Maryon-rd, Charlton, Kent
Humphrey, H. A., Engineering Manager, Messrs. Brunner, Mond and Co, Northwich
Hurley, E. B., Royal Colonial Institute, Northumberland-avenue, London, W.
Hutchinson, W. B., The Observatory, Liversedge, Yorks.
Imray, Harold, 28, Southampton-bldgs, London, W.C.; and The Grange, Underhill, New Barnet, Herts
Ivor-Moore, T., Fairfield Gold Tops, Newport, Mon.
Jacob, F., Ellesdene, Beaconsfield-rd, Westcombe Park, London, S.E.
James, Aubrey, 29, Nightingale-st, Abercanaid, Merthyr Tydvil
Jamieson, Prof. Andrew, M.Inst.C.E., F.R.S.E., &c., Glasgow and West of Scotland Technical College, Glasgow
Jamieson, W. R., c/o Wm. Cleghorn, jr, Clepington, Dundee
Jasper, W., Countess-pl, Nottingham
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Jenkins, T. C., City and South London Railway Company, 46, King William-st, London, E.C.
Jensen, H., Flodden House, Theydon Bois, Essex
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Johnson, Charles, Middlegate and Boar-lane, Newark
Johnson, G. W., 109, Welsh-row, Nantwich, Cheshire
Johnstone, Jas., 8, Merchison-park, Edinburgh
Johnston, W. H., 70, High-st, Southampton

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Jones, Prof. Viriamu, University College, Cardiff
Jones, William, 7, Goldney-rd, Clifton, Bristol
Jones, W. A., 69, King-st East, Rochdale
Joseph, Edward L., 92, Queen Victoria-st, London, E.C.
Keays, Arthur M., Wandle Cottage, Croft-rd, Sutton, Surrey
Keiffenheim, H., Monaise, Fernwood-rd, Newcastle-on-Tyne
Kelly, T., 22, Park-ter, Markfield-rd, Page Green, Tottenham, Middlesex
Kempster, J. W., 116, Upper Tulse-hill, London, S.W.
Kent, A. B., 47, Lansdowne-gdns, South Lambeth, London, S.E.
Keogh, R. W., 37, Great George-st, Cork; and Kilkee, R.S.O., co. Clare, Ireland
Kerr, George A., Woodside, Salter's-hill, Upper Norwood, London, S.E.
Kershaw, Abraham, Cankerwell-lane, Leeds
Ketley, Frederick W., 17B, Great George-st, London, S.W.
Kidby, E. C., 1, Darlington-rd, Havelock Park, Southsea, Hants
King, James, 18, Moodkee-st, Rotherhithe, London, S.E.
King, W. F., Loanend, Trinity, Edinburgh
Kingsland, William, 17, Avenue-rd, St. John's Wood, London, N.W.; and Clarence-bldgs, Gloddaeth-st, Llandudno
King-Smith, H., Kingsfield, Watford, Herts.
Kirk, S. G., Victoria-rd, Netherfield, Nottingham
Knight, Alfred W., Cuckfield, and Market-pl, Hayward's Heath, Sussex
Knowles, C. E., Holmdale, Glossop, near Manchester
Krause, A., 42, Hampton-rd, Redland, Bristol
Lamb, C. G., B.Sc., Engineering Department, The University, and 33, Regent-st., Cambridge
Lander, W. H., 33, Blessington-st, Dublin
Lane, D. W., Royal Dockyard, Portsmouth
Lane-Fox, St. George, 4, Grosvenor-gdns, London, S.W.
Lane, J. M., 103, Central-hill, Upper Norwood, London, S.E.; and at Folkestone
Langdon-Davies, C., 45, Redcliffe-sq, South Kensington, London, S.W.
Larmor, Dr. J., St. John's College, Cambridge
Larner, G., Darenth, Dartford, Kent
Laughton, Herbert F., 20, Warrington-crescent, Maida Vale, London, N.W.
LAURENCE, SCOTT & CO, Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**
Laurie, P., Dawlish-rd, Selly Oak, Birmingham
Lavender, J., Catherine-chmbrs, 11, Todd-st, Manchester
Lawrence, L. S., 24, Grove-villas, Poplar, London, E.
Lea, Frank J., Abbey Foregate, Shrewsbury
Leaf, H. M., 51, Locksley-st, Burdett-rd, London, E.
Lean, A. L. C. (Messrs. J. Davis & Son), All Saints' Works, Derby; and Flounders College, Ackworth, near Pontefract
Le Claire, August, 67, Praed-st, London, W.
Le Fall, F. W., 1, Melford-rd, Lordship-lane, London, S.E.
Lees, Charles H., B.Sc., Owens College, Manchester
Legg, W. A., Manchester Water Works, High Nest, Keswick
Lennard, F. B., M.A., United University Club, Pall Mall East, London, S.W.
Leskovic, Lionello, 30, Shenley-rd, Camberwell, London, S.E.
Lewis, Robert, 4, Glenmohr-ter, Hyde Vale, Greenwich, London, S.E.
Linay, J. Carter, 119 and 255, High-st, and Globe-lane, Chatham
Lister, F. L., Osborne-villa, Bromley, Kent
Livesey, A., 43, Bridge-st, Slaithwaite, Yorks
Livingston, James, Postal Telegraphs, Glasgow
Lloyd, C. Oliver, 39, Wellesley-rd, Wanstead, Essex
Lloyd, R. S., 90 and 92, Whitecross-st, London, E.C.
Lloyd, W. B., Bella Vista, Southwood Lawn-rd, Highgate, London, N.
Loch, David, 55, Calvert-rd, East Greenwich, London, S.E.
Lockhart, W. S., 67, Granville-pk, Blackheath, London, S.E.
Lockyer, N. J., Lenzie, N.B.
Lodge, Alfred, Cooper's Hill College, Staines, Middlesex
LORRAIN, J. G., Norfolk House, Norfolk-st, Strand, London, W.C. **See Advt., p. 573**
Louden, E. R., Uplands, Swansea
Louden, Edwin R., Uplands, Swansea
Lovett, Thomas, 15, Kilbowie-rd, Clydebank, Glasgow
Lovey, A. Feri, 20, The Common, Woolwich, London, S.E.
Lowdon, E. J. B., 21, Airlie-pl, Dundee
Lucas, R. N., Clareville, Galway
Lucas, Wm., M.A., 53, Thornhill-sq, London, N.
Lundberg, P. A., Bradbury Electrical Works, Bradbury-st, Kingsland, London
Luttrell, Edward H., 17, Portland-pl, Royal Canal, Dublin
Lydall, F., Siemens' Laboratory, King's College, Strand, London, W.C.
Lyon, H. C., 616, Mile End-rd, Bow, London, E.
MacCARTHY, C. C., Belfast Electrical Works, 23, Corporation-sq, and 16, William-st South, Belfast. **See Advt., p. 49.**
Macdermott, J., 10, Rochdale-rd, Oldham, Lancs.
Mackail, J. H. (Messrs. Johnson and Phillips), 66, Delafield-rd, Old Charlton, Kent
Maclean, Magnus, Physical Laboratory, The University, Glasgow
Macpherson, W., 42, Chalcot-cres, Regent's Park London, W.
MacMahon, Major P. A., R.A., F.R.S., Artillery College, Woolwich, Kent; and 40, Shaftesbury-avenue, London, W.
McElroy, John, 57, Clare-st, Limerick
McCraith, Jeremiah, The Elms, Melton Mowbray

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McMaster, James, Nether-lane, Llandudno
McMullen, J. A., 21, Carlton-hill, St. John's Wood, London, N.W.
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Maguire, J., 43, Watling-st, Dublin
Maling, Frederick T., 14, Ellison-pl, Newcastle-on-Tyne
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Mann, E., Palace Chambers, 9, Bridge-st, Westminster, London, S.W.
Mann, Geo. Edward, Baker-st, Enfield
Mann, J. J., Peel Mills, Manchester
Manners, H., 80, New Kent-rd, London, S.E.
Maples, E. R. (Brighton & Hove Electric Light Co, Limited), 46, Gloucester-rd, Brighton
Marr, Alexander, Collier-Marr Telephone and Electrical Manufacturing Company, Limited, Derby-st, Oxford-rd, Manchester
Marshall, A. W., 180, Loughborough-rd, Brixton, London, S.W.
Martin, W. G., 102, High-st, Stoke Newington, London, N.
Martin, W. W., Kidderminster
Marwood, A., 2, Catherington-villas, Campbell-rd, Southsea, Hants
Matson, Jessie, 10, Church-ter, Church-rd Willesden, London, N.W.
Mavor, Alfred E., Fowler-Waring Cables Company, Limited, North Woolwich, London, E.
Mavor, H. A., 57, West Nile-st, Glasgow
Maxim, Hiram S., Baldwyn's-pk, Bexley, Kent
May, John, 2, The Crescent, Richmond, Surrey
Mayer, John, Cathlin-rd, Langside, Glasgow
Maycock, W. Perren, 26, Stafford-rd, Croydon, Surrey
Meikle, Andrew W., M.A., 18, Cambridge-st, Glasgow
Middleton, Sam, 65, Southampton-st, Camberwell, London, S.E.
Miller, Leslie B., 2, Gray's Inn-rd, W.C., and 32, Belmont-rd, West Green, Tottenham, N., London
Miller, S., 1, Langton-cottages, Melbourne-sq, Brixton, London, S.W.
Millett, H. C., St. Catherine's Lighthouse, Niton, Isle of Wight
Mills, Arthur, 62, Great Percy-st, London, W.C.
Mills, A. E., M.A., 72, Upper Tollington-park, London, N.
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Mills, P. B., 67, Southwark Bridge-rd, London, S.E.
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Beddoe, Charles George, 29, Nine Elms-lane, Lambeth, London, S.W.
Benest, Henry, 15, Campbell-rd, Bow, London, E.
Bennett (J.) & Sons, St. Neots
Bentley & Co, 17, Newton-st, Piccadilly, Manchester
Beswick, Chas. W., Arley, Northwich, Cheshire
BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.
Bishop, Howard W., Sutton-rd, Walsall
Boardman's Electric Sun Lamp Patents, Limited, 238, Tottenham Court-rd, London, W.
Böhm (Ernest) & Co, Limited, 32, Gray's Inn-road, London, W.C.
Bolton & Sons, 47, West Nile-st, Glasgow
Booth, Henry, 80, Limehouse-st, Hull
Borland, F. J., 2, Sheepscar-gr, Benson-st, Leeds
Bostel (D. T.) & Son, 73, Ebury-st, London, S.W.
Bottone, S. R., Wallington, Surrey
Bowker, Bros, 270 St. Paul's-rd, Brighton

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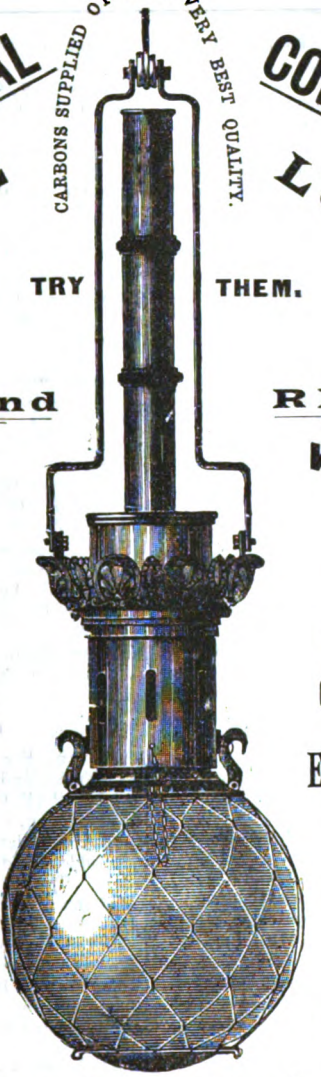

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BRISTOL ELECTRIC SAFETY LAMP WORKS, 63, Queen Victoria-st, London, E.C. **See Advt., p. 601**
Brooke, J., 9, Cross-st, Wakefield
Brown, F. G., North-st, Rushden
Brown, John, 120, Acre-lane, Oldham, Lancs.
BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, Lambeth, S.E., London
Bryant, George, 51, Cricketfield-rd, Hackney Downs, London, N.E.
Cafferata, H. W., 58, Holt-rd, Liverpool
Caldwell, W. E., 27, South Sherwood-st, and Rigley's Yard, Nottingham
Calipe, Dettmer & Co, 21, Poland-st, London, W.
Chapman & Son, 11, Waterloo-road, and 17, James-st, Liverpool
Chutter, G. F., Buckingham-st, Birmingham
Clare, John E., 55, Boundary-lane, West Derby-rd, Liverpool
CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, London, S.W. **See Advt., p. 59**
CLARKE, CHAPMAN & CO, Limited, Victoria Works, Gateshead-on-Tyne. **See Advt., p. 46**
Claxton, W. Newman, West-st, Alford, Lincolnshire
Clay, R. C., 35, Kenwyn-rd, Clapham, London, S.W.
Cole, John Robert, 67, Freeman-st, Great Grimsby
Connolly Bros, Blackley, Manchester. **See Advt., p. 475**
Cooke & Askew, Playfair-rd, Southsea
Cooper & Pannett, 169, Gray's Inn-rd, W.C., and 82, Newman-st, W., London
Corse (W. J.) & Co, 17, Old Town-st, and Market-pl, Plymouth
Coveney Bros., 67, King-st, Ramsgate
Cox, Fredk. J., 56, Terminus-rd, Eastbourne
Cox-Walkers, North-Eastern Electrical Works, Darlington; and 9 and 13, West Register-st, Edinburgh
Croggon & Co, Limited, 16, Upper Thames-st, London, E.C.; 19, Tithebarn-st, Liverpool; and 7, John-st, Glasgow
Curtis Bros, 10, Suffolk-st, Dublin
DALE, E. R., Greenhill, Sherborne, Dorset
DALE, H. J., 7 and 8, Dyer's-buildings, London, E.C.
Davison, Alex., 47, London-st, Glasgow
Davis, Gabriel, St. Helen's Wharf, Thames Wharf, Abingdon
Dawkins, W. A., 8, Warstone-parade East, Birmingham
DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocers'-hall-ct, Poultry, London, E.C. **See Advt., p. li**
DRAKE & GORHAM, 66, Victoria-st, London, S.W. **See Advt., p. 15**
Durrant, A. T., 4, Queen-st, Great Yarmouth
Dyer, W. H., 116, St. John-street-rd, London, E.C.
Edison and Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570, and 572**
Edwards, George & Thomas, 70, Wellington-st, Glasgow
Edwards & Pinder, 18, Catherine-st, Strand, London, W.C.
ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st, London, E.C.; and Wolverhampton
Electric Light Regulating Syndicate, Limited, c/o Mr. Adrian C. Collins, 61, Old Broad-st, London, E.C.
Electric Meter Company, Limited, 18, Eldon-st, and 19, Finsbury-circus, London, E.C.
Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.
ELECTRICAL COMPANY, Limited, 122 and 124, Charing Cross-road, London, W.C. **See Advt., p. 539**
ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt. on back cover**
Electrical Purification Association, Limited, 193, King-st, Westminster, London, S.W.
ELLIOTT BROS, 101, St Martin's-lane, London, W.C. **See Advt., p. 518**
Eymers, F. C., 19, Upper Woodland-ter, Charlton, London, S.E.
Faraday & Son, 3, Berner's-st, London, W.
Faulkner, J., 13, Great Ducie-st, Strangeways, Manchester
FERRANTI, S. Z. DE, Limited, St. Benét-chbrs, Fenchurch-st., and 27, Charterhouse-sq, London, E.C. **See Advt., p. 594**
Field & Son, Market-sq, Aylesbury
Fiford (E. T.) & Sons, 63, Northam-rd, Southampton; and at Bournemouth
Fleming (Hugh) & Co., 1, Teviot-pl, and 3, Rose-st, Edinburgh
Fletcher, G. E., The Homestead, Cale Green, Stockport
Fowler, Lancaster & Co, Limited, Albert Works, Graham-street, Birmingham
Frank (G.) & Co, Limited, 25, Blandford-st, and 15, Dorset-mews East, London, W.
Franks, A., 2, King-st, 95, Deansgate, and 44, Market-st, Manchester
Fuller (J. C.) & Son, 547, Old Ford-rd, London, E.
Gardner & Co, 53, St. Vincent-street, Glasgow
Garnham & Co, Sash-ct, Wilson-st, Finsbury, London, E.C.
Garrett, F. T. & A., High-st, Dunstable; and High-st, Towcester
GENERAL ELECTRIC COMPANY, Limited 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham, and Manchester. **See Advt., p. 486**
GENT & CO, Braunstone-gate, Leicester; 3, Maiden-lane, Queen-st, London, E.C.; 47, High Bridge, Newcastle-on-Tyne; 27, Oswald-st, Glasgow; and at Cardiff and Belfast
Gill & Co, 4 and 5, High-st, Oxford
Gillmore, G., 10, Athol-st, Douglas, Isle of Man
Goodland, W., Sherborne, Dorset
Goodwin, Robert, 24, Exchequer-st, Dublin
Grant (T. C.) & Co, Queen's-rd, Watford
Granville, W. P., Vulcan Works, Vesey-st, Birmingham
Gray (E.) & Son, 46 and 47, Clerkenwell Green, London, E.C

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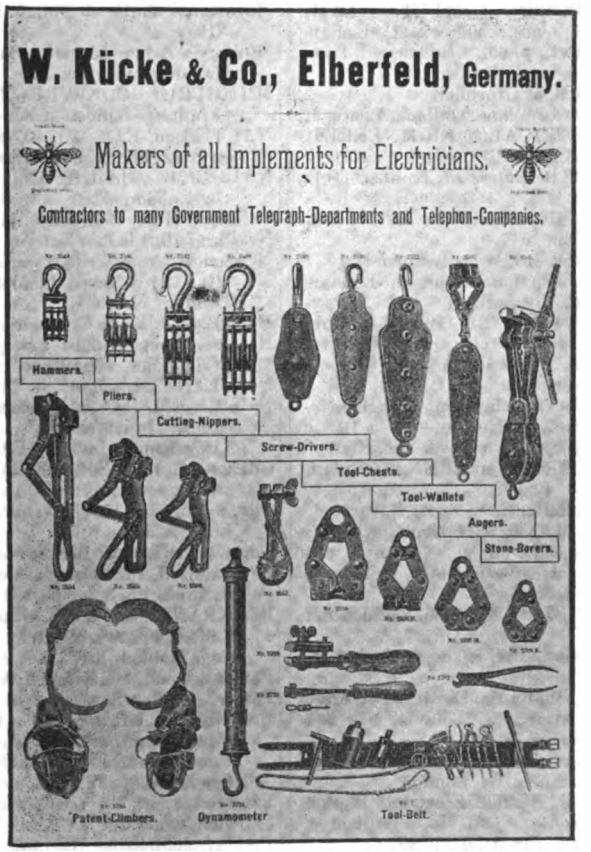

Gray, H. & W., 81, Stonebridge-rd, Stamford Hill, London, N.

Gray (J. W.) & Son, 113, Leadenhall-st, London, E.C.

Green & Treacher, 77, Cannon-st, and Old-st, London. E.C.

GREENHILL, J. H., (New) King-st, Belfast. **See Advt., p. 37**

Greenwich Electrical Works, 6, Nelson-st, Greenwich, London, S.E.

Haine & Co, 29, Hereford-rd, Bayswater, London, W.

Halhead, J. A., Currock, Carlisle

Hall, C. F. N., Victoria Works, Crockett's-lane, Smethwick

Harrison, R. H., Scientific Works, Bridgnorth

Haseler (Chas.) & Son, 94, Bridge-st. West, Birmingham

Haslam, A. P., 81, St. Dunstan's-rd, West Kensington, London, W.

Haycraft & Son, Limited, 45, Broadway, Deptford, and Lewisham, London, S.E.

Hewes & Geary, Church Gresley, Swadlincote, near Burton-on-Trent

Highton, E. G., Eagle Foundry, Graham-st, City-rd, London, N.

Hirst (A.) & Son, Foundry-st, Dewsbury

Hitchcock, W. M., Westbank, Alton, Hants

Holt, William, 83, Snargate-st, Dover

Hooydonk, F. Van, 750, Holloway-rd, London, N.

Horrocks, Joseph, 10, Union-st, Southport

Howe, William, 87, Clarence-road, New Cut, Bristol

Hutchings, Arthur, 88, Copleston-rd, Peckham, London, S.E.

Hyde, John Derby, Bloxham, Banbury, Oxon

Imrie, John E. Wilson, Holm-next-the-Sea, King's Lynn

International Electric Company, 55, Red Cross-st, London, E.C.

Jackson, W. H., Grantham

Jacob, A., 86, Colveston-cres, Dalston, London, N.E.

James, Henry J., 135, Cowick-st, St. Thomas, and 63, Bonhay-rd, Exeter

Jenkin, B. M., 29, Whitehall-court, Whitehall, London, S.W.

JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C.; and Charlton, Kent. **See Advt., p. 3**

Johnson, W. H., Lynn

Johnstone (W. H.) & Co, Howe Electrical Works, Irvine-st, Liverpool, E.

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Kelso & Co, 2, Commerce-st, and 21, Clyde-pl, Glasgow
King, J. R., 11, Albemarle-st, Clerkenwell, London, E.C.
KING, MENDHAM & CO, Western Electrical Works, Narrow Wine and Fairfax-sts, Bristol; and 12, Fenchurch-st, London, E.C.
LAING, WHARTON & DOWN, 82A, New Bond-st, W., and 17, Gracechurch-st, E.C., London; and Guardian-bldg, Manchester. **See Advt., p. 42**
Lalonde Bros, 2, High-st, Weston-super-Mare
Lane, F. W., The Electrical Stores, 67, Cotham-hill, West Park, Bristol
LAURENCE, SCOTT & CO, Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**
Laurie, E. H., 16, Blandford-sq, London, N.W.
Leake, Walter, 30, Victoria-bldgs, Manchester, and 35, Dame-st, Dublin
Ledger, P. G., Mayfield, Eltham-rd, Lee, Kent
Lee, Allen, 98, King's-rd, Camden Town, London, N.W.
Liley (Wm.) & Co, 6, Renshaw-street, Liverpool
Lockyer (W. A.) & Co, Merstham, Redhill, Surrey
Long, Thomas E., 1, Queen's-bldgs, Hastings; and at St. Leonards
Lowndes, Chas. E., 27, St. Maur-rd, Fulham-rd, London, S.W.
Lowrance (M.) & Son, Peel-sq, and Market-st, Barnsley, Yorks.
Lundberg, A. P., Bradbury Electrical Works, Bradbury-st, Kingsland, London, N. **See Advt., p. 619**
Mabon (A.) & Co, 10, West Campbell-st, Glasgow
MacCARTHY, C. C., Belfast Electrical Works, 23, Corporation-sq, and 16, William-st South, Belfast. **See Advt., p. 49**
M'Ghie & Co, 75, Vincent-st, Glasgow
MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chambrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**
Marsh, T. E., 42, Reighton-rd, Upper Clapton, London, N.E.
Marson (F.) & Co, King Richard's-rd, Leicester
Martin, W. W., Worcester Cross, Kidderminster
Mason (Joseph) & Co., 8, Suffolk-lane, London, E.C.
MATTHEWS & CO, Oxendon-st, Leicester
Mattinson, J., 179, Latham-st, Liverpool
Melhuish (R.) & Sons, 84-87, Fetter-lane, London, E.C.
Meteyard & Haine, 43, Archer-st, Notting Hill, London, W.
Midgley & Sutcliffe, Bradford, Yorks.
Mildé (Ch.) & Co (Representative in England, M. Kotyra), 60, Watling-st, London, E.C.
Millar, Harry, 14, Deansgate, Manchester
Miller & Woods, 2, Gray's Inn-rd, Holborn, London, W.C.
Mills (John) & Son, 23, Collingwood-st, Newcastle-on-Tyne
Money & Nash, 19, Palace-gdns-mansions, Notting Hill, London, W.
Morris Bros, Limited, Great Hampton-st, Birmingham
Moss, W., 9, Station-rd, Redhill, Surrey
Muckle, P., 2, Bowles-pl, Whetstone, London, N.
Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.
MUIRHEAD & CO, 2, Princes-st, Great George-st, London, S.W. **See Advt., p. 521**
NALDER BROS. & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 499**
NALDER & HARRISON, Trafalgar House, Great Newport-st, Charing Cross-rd, London, W.C. **See Advt., p. 523**
Neville (Julius G.) & Co, Oriel-chmbrs, Liverpool
Newton & Savage, 7, Tysoe-st, Clerkenwell, E.C.
Nickolls (R.) & Sons, 6, Lenthall-rd, Dalston, London, N.E.
Nicholson, F. B., 5, Crown-ct, London, E.C.
Noakes, Thomas A., 10 Priory-st, and 3, Cambridge-gdns, Hastings
Nott, C. H., Barrington-st, Tiverton, Devon
NUSSBAUM, G. A. (General Agent for the Société Industrielle des Téléphones), 29, Ludgate-hill, London, E.C.
Odhams, J. & G., 206 and 207, Upper Thames-st, London, E.C.
Ogg, F. William, 162, Claremont-rd, Forest Gate, London, E.
Omnibus & Tramcar Electric Lighting Company, Limited, 18, Eldon-st, London, E.C.
Palmer (John) & Sons, 58, Queen's-rd, Clifton
Parnall (William) & Co, Limited, Victoria-st, and Temple-st, Bristol; and 15, Seething-lane, London, E.C.
Parsons, E. M., 10, Paragon-st, Hull
Pasley, —, Sherborne, Dorset
PATERSON & COOPER, European Works, Pownall-rd, N.E., and 68, Victoria-st, S.W., London; and 137, West Regent-st, Glasgow. **See Advt., p. 39**
Paterson & Son, 26, Woodbridge-st, Clerkenwell, London, E.C.
PAUL, ROBERT W., 44, Hatton-gdn, and Leather-lane, London, E.C. **See Advts., pp. 524 and 641**
Peppercorn Bros., 15-19, Broadway, Deptford, London, S.E.
Perrow, W. H., 8, King-st, Truro
Perry (John) & Sons, Cork
Phillips, H. Fentum, Stoke, Guildford
PITKIN, JAMES, 56, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 491**
PLANET ELECTRICAL ENGINEERING COMPANY, Limited, 28, Victoria-st, S.W., and 67, Piccadilly, W., London; and 150A, North-st, Brighton
Player & Retallack, 36, Moorgate-st, London, E.C.
Pollitt, John, 43, Lower Mosley-st, Manchester
POOLE & WHITE, Limited, 58 & 59, Bread-st, London, E.C. **See Advt., p. 620**
Poole, J., 84, Heywood-st, Moss Side, Manchester
Pope (W.) & Sons, Limited, Gotha Iron Works, Slough, Bucks; and Broad-st House, Old Broad-st, London, E.C.
Porter, C. V., 30, Warham-rd, Harringay, London, N.
Powell (James) & Son, 26, Tudor-st, Whitefriars, London, E.C.
PYKE, HARRIS & CO., Limited, 33 and 34, New Tothill-st, Westminster, London, S.W.

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Quincey Bros., 146, Seven Sisters-rd, South Tottenham, London, N.
RAINS, MIDDLETON & CO, 34, Victoria-st, London, S.W. **See Advt., p. 574**
Rawlings Bros., 82, Gloucester-rd, South Kensington, London, S.W.
Rayment, L., Cradley, Staffs.
Rees, John Price, 23A, New Kent-rd, London, S.E.
REID BROS, 12, Wharf-rd, City-rd, London, N. **See Advt., p. 14**
Richardson, C. D., 17, Cross-st, Hatton-gdn, London, E.C.
Riddell, J. G., 18, King-st, Manchester
Riddle, Edward, Low Leam, Glenluce-rd, Westcombe-park, London, S.E.
Rigg, Arthur, 42, Old Broad-st, London, E.C.
Roberts, Frederick, 62, Eldon-st, Walsall
Robertson, George, jun., 9, Old Sneddon-st, and 4, New Sneddon-st, Paisley
Round, John, 3, Marmont-rd, Peckham, London, S.E.
ROUTLEDGE, WILLIAM, 46, Low Friar st, Newcastle-upon-Tyne
Rowland (W. H.) & Co, 308, Stretford-rd, Manchester
ROYCE (F. H.) & CO, Cooke-st, Hulme, Manchester. (*Switch Manchester, Nat. 772*)
Russell (John) & Co, 6, 8, and 10, Colston-st, Bristol
Salanson (A.) & Co, 28, High-st, and 27, Bridge-st, Bristol
Sanderson (C. J.) & Sons, 30, Featherstone-st, City-rd, London, E.C.
Saunders (J. B.) & Co, Cardiff
Sax (Julius) & Co, Limited, 7, Ridgmount-st, Bedford-sq, W.C., and 366, Central Markets, West Smithfield, E.C., London
Scientific Alliance, 7 and 8, Dyer's-bldgs, Holborn, London, W.C.
Shalders, F., 17, High-st, Southampton
Shillingford Works Co, Ltd, Wallingford, Berks
SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**
Smith, G. E., 53, Mapperley-rd, and 3, Spruce-yard, N. Sherewood-st (late of 4, Cranmer-st), Nottingham
Smith & Robinson, 42, Spencer-st, Clerkenwell, London, E.C.
SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.
Stanley & Dawkins, 8, Warstone-parade East Buckingham
Stevens, Robert, 10½, Baron-st, Pentonville, London, N.
Stocker & Co, 83, Upper Thames-st, London, E.C.; and at Leipzig, Hamburgh, and Cologne
Sutcliffe, J. T., Ohm Works, 153, South-st Sheffield
Swann, G., 33A, Earl's Court-rd, Kensington, London, S.W.
SWINBURNE & CO, Limited, Broom Hall Works, Teddington. **See Advt., p. 637**
SWINTON (A. A. C.) & CO., 66, Victoria-st., London, S.W.
Talbot, Robert, 204, Gorton-lane, West Gorton, Manchester
Taylor (James) & Son, West st, Ilminster
Taylor & Parsons, Bank-st, Bradford
Tett, Henry S., Market st, Faversham
THAMES IRONWORKS & SHIPBUILDING COMPANY, Limited, Orchard-yard, Blackwall, London, E. **See Advt. inside back cover**
THOMPSON, N. G., 13, Victoria-st, London, S.W. **See Advt., p. 13**
Thompson, W., Crompton Fold, Shaw, near Oldham, Lancs.
Thurkle & Co, 22, Denmark-st, Soho, London, W.C.
Townsend (Hy. A.) & Co, 367, St. James's-rd London, S.E.
Ungard (Julius) & Co, 327, Upper-st, London, N.
Venman, H., 20, Pimlico-rd, London, S.W.
VERITY (B.) & SONS, 31 and 32, King-st, Covent Garden, W.C., and 137, Regent-st, London, W.; Plume Works, Aston, Birmingham; and 29, Princes-st, Manchester
Wainwright, C., 1, Church-st, Castleford
Walker (Sydney F.) & Co, Cardiff Electrical Works, Severn-rd, and 33, Castle-st, Cardiff
Wallis Bros, 156, High-st, Lincoln
Walters (Philip) & Co, 249 and 251, Kensal-rd. and Conlan-st, London, W.
Ward & Adams, 171, Harold-rd, Upton-park, London, E.
Ward Bros. & Co, 11, Binden-rd, Shepherd's Bush, London, W.
Ward (J. H.) & Co, Gordon Brook Electric Works, Manchester
Warwick, Benjamin, 134, Highbury-hill, London, N.
Watkinson (W. J.) & Co. 9, Union-st, Southport
WESTINGHOUSE ELECTRIC COMPANY, Limited, 32, Victoria-st, London, S.W. **See Advt., p. 487**
Weston, A., 177, Harrow-rd, London, W.
Westwood (A.) & Son, 21, Prince's-st, Perth
Wetton & Co, 98, High-st, Cheltenham
WHITAKER, JAMES, 191, Earl's Court-rd, London, S.W.
Whitaker, John, 7, Clifton-rd, Eccles
Whitaker & Pollitt, Blackfriars, Manchester
White, T. M., 9, Mill-st, Hanover-sq, London, W.
Wilcox, George, 116, Shakespeare-rd, Stoke Newington-rd, London, N.
Wise (W. L.) & Co, 66, Fore-st, London, E.C.
Wood & Horspool, Newport, Isle of Wight
Wood, S. P., 10, Paragon-st, Hull
Woodhouse & Johnson, 49, Durham-rd, Darlington
WOODHOUSE & RAWSON UNITED, Limited, 88, Queen Victoria-st, London, E.C. **See Advt., p. 55**
Wright, John, 87, Leach-st, Farnworth
Wyatt Bros, Wayland Works, Whitchurch, Salop
ZIMDARS, C. E., 327, Gray's Inn-rd, London, W.C.

Medical.

Bishop, W. J., 74, George-st, Croydon
Curtis Bros, 10, Suffolk-st, Dublin
Horrocks, Peter, M.D., 26, St. Thomas's-st, London, S.E. (To Guy's Hospital)
Sherborne Electric Installation, Sherborne, Dorset
Watteville, A. de, M.D., 30, Welbeck-st, Cavendish-sq, London, W.

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ELECTRICITY METERS, MAKERS OF.

(*See also* **Meters, Electric.**)

ANDERS' TELEPHONE COMPANY, Limited, Telephone-bldgs, 31, Queen Victoria-st, London, E.C. **See Advt., p. 630**

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, S.E., London

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570, and 572**

ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st, London, E.C.; and Wolverhampton

Electric Meter Company, Limited, 18, Eldon-st, and 19, Finsbury-cir, London, E.C.

ELECTRICAL COMPANY, Limited, 122 and 124, Charing Cross-rd, London, S.W. **See Advt., p. 539**

Frager—Wilson, R. P., 3, Princes-mansions, 68, Victoria-st, London, S.W.

FERRANTI—Ferranti, S. Z. de, Limited, St. Benet-chmbrs, Fenchurch-st, and 27, Charterhouse-sq, London, E.C. **See Advt., p. 594**

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C.; and Victoria Works, Charlton, Kent. **See Advt., p. 3**

LAURENCE, SCOTT & CO, Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**

NALDER BROS & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 499**

Oulton-Edmondson—Edmondson, Joseph, Albert Electrical Works, Hay-st, Longside-lane, Bradford. (Sole Maker)

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

Swinburne & Co., Limited, Broom Hall Works, Teddington. **See Advt., p. 637**

WATERHOUSE ELECTRICAL MANUFACTURING COMPANY, Limited, 67, Southwark Bridge-rd, London, S.E. **See Advt., p. 443**

WESTINGHOUSE ELECTRIC COMPANY Limited, 32, Victoria-street, London, S.W. **See Advt., p. 487**

White, James, 16-20, Cambridge-st, Glasgow

ELECTRICITY SUPPLY COMPANIES.

For CENTRAL LIGHTING STATIONS OF THE UNITED KINGDOM, *see folding sheet, page* **158**

For list of **Central Stations, Contractors for the Construction and Maintenance of,** *see page* **457**

For PROVISIONAL ORDERS granted by the Board of Trade during 1893, *see page* **160**

For ELECTRIC LIGHTING NOTICES FOR 1894, *see page* **161**

Aurora Electric Lighting and Distribution Company, Limited, 54, New Broad-st, London, E.C.

Bedford Electric Light Company, 3, St. Paul's-sq, Bedford

Bicester Electricity Supply Company, Limited, Market-hill, Bicester, Oxfordshire

Birmingham Electric Supply Company, Limited, 14, Dale-end, Birmingham

Birmingham House-to-House Electricity Company, Limited, 39, Bennett's-hill, Birmingham

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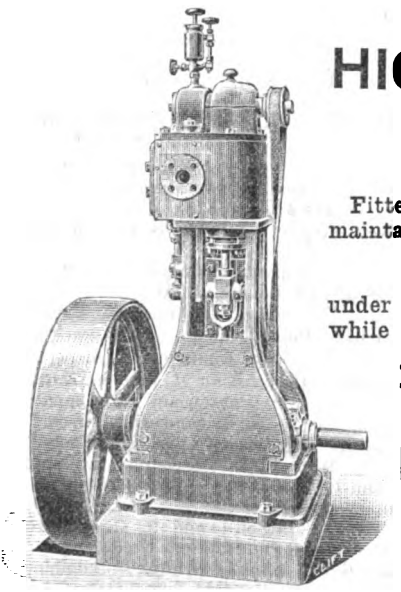

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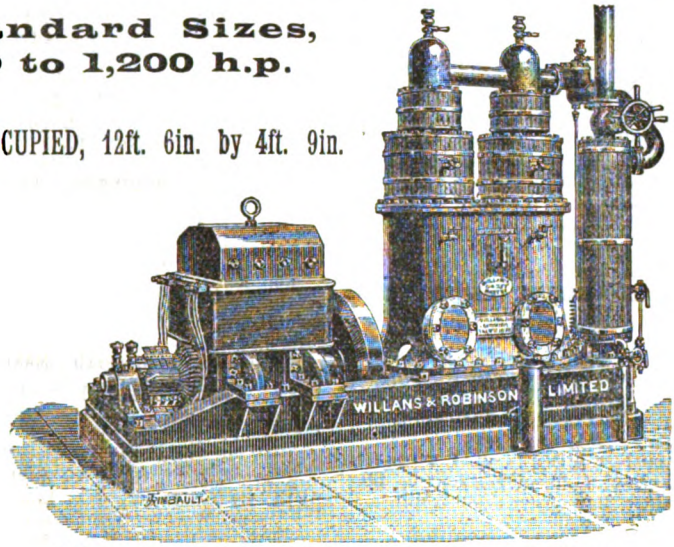

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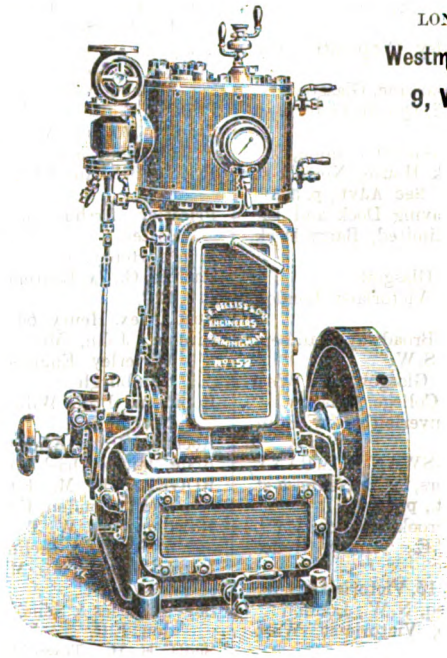

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EASTON & ANDERSON, Limited, 3, Whitehall-pl, London, S.W.; and Erith, Kent **See Advt., p. 516**

Engineering Supply Company, Limited, Stockton Forge, Stockton-on-Tees

Evans (Joseph) & Sons, Wolverhampton; and 16, Union-court, Old Broad-st, London, E.C.

Fairfield Shipbuilding & Engineering Company Limited, Govan; and 113, Cannon-st, London, E.C.

Firth (Thomas) & Sons, Limited, Norfolk Works, Sheffield; and 110, Cannon-st, London, E.C.; and at Birmingham and Manchester

Foot (Rowland G.) & Co, 153, Fenchurch-st, London, E.C.

Fowler (John) & Co, Leeds, Limited, 6, Lombard-st, London, E.C.; and Steam Plough Works, Leeds

Gadd, Thomas, Ross Rivet Works, Rowley Regis, near Dudley; and at Salford

GOOLDEN (W. T.) & CO, Woodfield Works, Harrow-rd, London, W.

Grafton & Co, 113, Cannon-st, London, E.C.; and Vulcan Works, Bradford

Grantham Crank and Iron Company, Limited, Grantham

Green (Thomas) & Son, Limited, Smithfield Iron Works, Leeds; and Surrey Works, Blackfriars-rd, London, S.E.

Gwyn, A. E. W., 114A, Queen Victoria-st, London, E.C.

Harland & Wolff, Belfast

Harpers Limited, Aberdeen

Harrison, Ainslie & Co, Limited, 23, Abingdon-st, Westminster, London, S.W.

Harvey & Co., Limited, Hayle and Falmouth, Cornwall; and 186, Gresham House, Old Broad-st, London, E.C.

Hastie (J.) & Co, Kilblain Engine Works, Nicholson-st, Greenock

Hawthorn (R. & W.), Leslie & Co, Limited, St. Peter's Works, Forth Banks Works; Hebburn Shipbuilding Yard, Newcastle-on-Tyne; and 138, Leadenhall-st, London, E.C.

Head, Wrightson & Co, South Stockton, Yorks; and 5, Victoria st, London, S.W.

Hick, Hargreaves & Co, Limited, Soho Iron Works, Bolton

HINDLEY, E. S., 11, Queen Victoria-st, London E.C.; and Bourton, Dorset. **See Advts., pp. 553 and 764**

Holmes (W.), Cartwright & Co, 80, Cannon-st, London, E.C.

Hooker, Peter, Pear Tree-ct, Farringdon-rd, London, E.C.

Horseley Company, Limited, Tipton, Staffs.; and 11, Victoria-st, London, S.W.

Hughes & Gotto, 8, Highgate-rd, London, N.W.

Hydes & Wigfull, Stanley-st, Wicker, Sheffield

Ingham, W. P., Middlesborough

Isca Foundry Company, Newport, Mon.; and 10, Bush-la, London, E.C.

JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C.; and Victoria Works, Charlton, Kent. **See Advt., p. 3**

Johnston (James) & Co, 4, Corporation-st, Manchester

Jones, Burton & Co, 19, Castle-st, Liverpool

Jones, Herbert, 69, Hope-st, Liverpool

Kitson (Sir James) & Co, Airedale Foundry, Leeds; and 3, Victoria-st, London, S.W.

Ladd (John H.) & Co, 116, Queen Victoria-st, London, E.C.

Leeds Forge Company, Limited, Leeds; and 63, Queen Victoria-st, London, E.C.

Lecte, Edwards & Norman, Limited, 366 and 368, Euston-rd, London, N.W.

Liverpool Engineering and Condenser Company, Limited, 21, Brasenose-rd, Liverpool

Lloyd & Davis, 64, Sumner-st, Southwark, London, S.E.

Macfarlane (Andrew) & Co, 59, Southwark Bridge-rd, London, S.E.; and 18, John-st, Sunderland

Macfarlane (Walter) & Co, Saracen Foundry, Possilpark, Glasgow

MacNee & Co, 3, Victoria-st, London, S.W.

Maginnis, J. P., 9, Carteret-st, Westminster, London, S.W.

Mann (G.) & Co, Paragon Works, Elland-rd, Leeds; and 18, Clifton-st, London, E.C.

Marchant, Young & Co, Limited, 166, Clerkenwell-rd, London, E.C.

Marshall, Sons & Co, Limited, Gainsborough, Lincs.; and 79, Farringdon-rd, London, E.C.

Martin & Son, Vine-st, York-rd, Lambeth, London, S.E.

MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. (*Mather Manchester: Bathmetal London*)

Munro, Robert W., Granville Works, Granville-pl, King's Cross-rd, London, N.

Napier Bros, Limited, 100, Hyde Park-st, Glasgow

Napier (D.) & Sons, Vine-st, and 68, York-rd, Lambeth, London, S.E.

NAPIER (R.) & SONS, Govan, Glasgow. **See Advt., p. 612**

Nott (J. E.) & Co, High-st, Brecon, South Wales

Olrick (Lewis) & Co, 27, Leadenhall-st, E.C.; and 57, Pennyfields, Poplar, E., London

Peckett & Sons, Atlas Engine Works, Bristol

Peirson & Co, 124, Fenchurch-st, London, E.C.

Penn & Son, 40, Westbury-st, Wandsworth-rd, London, S.W.

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PHOSPHOR BRONZE COMPANY, Limited, 87, Sumner-st, Southwark, London, S.E.; Bagot-st, Birmingham; and Etruria, Hanley. **See Advt., p. 438**
Reed, Blight & Co, Limited, 47, Victoria-st, London, S.W.; and Eagle Works, Plymouth
Richards, Thomas Percival, 174, Beckenham-rd, Penge, S.E., and 3, Victoria-st, S.W., London
Richardson (T.) & Sons, Hartlepool
Robey & Co, Ltd, Globe Works, Lincoln; and 117, Cannon-st, London, E.C.
Robinson (F. A.) & Co, 69, Cornhill, London, E.C.
Robinson (Thomas) & Son, Limited, Railway Works, Rochdale
Ruston, Proctor & Co, Limited, Sheaf Iron Works, Lincoln; and 20, Budge-row, London, E.C.
Samuelson & Co, Limited, Britannia Works, Banbury, Oxfordshire
Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.
Scott (George) & Son, 44 and 46, Christian-st, London, E.
Smith (A. and W.) & Co, Eglington Engine Works, Glasgow; and 17, Victoria-st, London, S.W.
SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon; and Cromwell Iron Works, Croydon
Stone (J.) & Co, Deptford, London, S.E.
Stothert & Pitt, Limited, Bath; and 30, Walbrook, London, E.C.
THAMES IRONWORKS & SHIPBUILDING COMPANY, Limited, Orchard-yard, Blackwall, London, E. **See Advt. inside back cover**
Thompson, James and George, Limited, Clyde Bank, Glasgow
Thompson, John, Ettingshall, Wolverhampton; and 73, Queen Victoria-st, London, E.C.
URQUHART & SMALL, 17, Victoria-st, London, S.W.
Vesey (H. J.) & Co, 10, Close, Newcastle-on-Tyne
Waygood (R.) and Co, Falmouth-rd, Great Dover-st, S.E., and 101, Leadenhall-st, E.C., London
West (H. J.) & Co, 116 and 118, Southwark Bridge-rd, London, S.E.
Weston & Co, Dover
Whitworth (Sir J.) & Co, Limited, Whitworth-st, Openshaw, Manchester; and 32, Victoria-st, London, S.W.
WILLANS & ROBINSON, Limited, Ferry Works, Thames Ditton, Surrey; and 3, York-st, Lambeth, London, S.E. **See Advt., p. 555**
Wood, J. & E., Spa-rd, Bolton, Lancs.
Worth, Mackenzie & Co, Limited, Stockton-on-Tees
YOUNGS, Ryland-street Works, Birmingham

ENGINEERS (HYDRAULIC).

ALLEN (W. H.) & CO, York-street Works, Lambeth, London, S.E. **See Advt., p. 37**
BELLISS (G. E.) & CO, Ltd, Ledsam-st Works, Birmingham; and 9, Victoria-st, London, S.W. **See Advt., p. 558**
Bristowe (L. Hugh) & Co, Albany-bldgs 47, Victoria-st, London, S.W.
Christy Bros., Broomfield Works, Chelmsford
ELECTRICAL INSTALLATION COMPANY, Ltd, 64 and 66, Victoria-st, London, S.W.
Evelyn-Liardet, J., 9, Bridge-st, Westminster, London, S.W.
General Hydraulic Power Company, Limited, 9, Bridge-st, Westminster, London, S.W.
Hett, Chas. Louis, Brigg, Lincolnshire
HINDLEY, E. S., 11, Queen Victoria-st, London, E.C.; and Bourton, Dorset. **See Advts., pp. 553 and 764**
HOWES, SIMEON, 64, Mark-lane, London, E.C. **See Advt., p. 639**
Le Grand & Sutcliffe, 125, Bunhill-row, London, E.C.
Leeds Engineering and Hydraulic Company, Providence Works, Leeds
MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. (*Mather Manchester; Bath-metal London*)
Middleton, Robert, Sheepscar Foundry, Leeds
NELL, FREDERIC, 16, Mark lane, London, E.C.
Ransome & Marshall, 67, Tithebarn-st, Liverpool
Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-court, Cheapside, London, E.C.
Severn Water Power Company, Shrewsbury
Tylor (J.) & Sons, Limited, 2, Newgate-st, London, E.C.
Warner (Robert) & Co, 27, Jewin-cres, London, E.C.; and Engineering Works, Walton-on-the-Naze, Essex
YOUNGS, Ryland-street Works, Birmingham

ENGINEERS (MECHANICAL).

ALLEN (W. H.) & CO, York-street Works, Lambeth, London, S.E. **See Advt., p. 37**
Armstrong (Sir W. G.), Mitchell & Co, Limited, Elswick Works, Newcastle-on-Tyne; and 8, Great George-st, London, S.W.
BAGSHAWE BROS. & CO., 4A, Upper Thames-st, London, E.C. **See Advts., pp. 606 and 617**
BELLISS (G. E.) & CO, Limited, Ledsam-street Works, Birmingham; and 9, Victoria-st, London, S.W. **See Advt., p. 558**
Bennie, J. R., 35, Queen Victoria-st, London, E.C.
Bennis (Ed.) & Co, Limited, Lancashire Boiler Works, Bolton, Lancs.
BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, S.E., London
Carter (J.), Sons & Co, New Bailey-st, Salford
Chaplin (A.) & Co, Cranston-hill Engine Works, Glasgow
Claypoole, W., Phœnix Electrical and Mechanical Engineering Works, Phœnix-st, Derby
Conrady (Eugen) & Co, Fleece Mills, Keighley
CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**
DAVEY, PAXMAN & CO, Standard Iron Works, Colchester; and 78, Queen Victoria-st, London, E.C. **See Advt., p. 51**

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DUTTON & CO, Limited, Railway Signal Works, Worcester; and 70 and 71, Palace-chmbrs, Westminster, London, S.W.

EASTON & ANDERSON, Limited, 3, Whitehall-pl, London, S.W., and Erith, Kent. **See Advt., p. 516**

ELECTRICAL INSTALLATION COMPANY, Limited, 64 and 66, Victoria-st, London, S.W.

FERRANTI, S. Z. DE, Limited, St. Benet-chmbrs, Fenchurch st, and 27, Charterhouse-sq, London, E.C. **See Advt., p. 594**

Fowler's Engineering Company, Limited, 98, Tooley-st, London, S.E.

Gannon, W. E., 17 and 18, Springfield Hill, Chelmsford

GLOVER (W. T.) & CO, Salford, Manchester; and 39, Victoria-st, London, S.W. **See Advt., p. 40**

Goodland, W., Sherborne, Dorset

Goulty, Wallis Rivers (Wheatley Kirk, Price & Goulty), Albert-chmbrs, Albert-sq, Manchester

Greenwood & Batley, Limited, Albion Works, Armley-rd, Leeds; and 16, Great George-st, London, S.W.

Handyside (Andrew) & Co, Limited, 104, Queen Victoria-st, London, E.C.; and at Derby

Henderson, Thomas, 6 and 8, Truman-st, Liverpool

HINDLEY, E. S., 11, Queen Victoria-st, London, E.C.; and Bourton, Dorset. **See Advts., pp. 553 and 764**

Holman, Stephen, M.I.C.E., 15, Great George-st, London, S.W.

Horton & Son, Limited, Darlaston, Staffs; and 110, Cannon-st, London, E.C.

Johnson, William, Castleton Foundry, Armley, Leeds

Johnson's Patents, Limited, Oak-street Works, West Gorton, Manchester

LAURENCE, SCOTT & CO, Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**

Lee, Allen, 98, King's-rd, Camden Town, London, N.W.

MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. (*Mather Manchester; Bath-metal, London*)

Maxwell (James) & Son, King's-rd, Dundee

Melling, James, 9, New Broad-street, London, E.C.

Munro, Robert W., Granville Works, Granville-pl, King's Cross-rd, London, W.C.

NALDER BROS & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 599**

POOLE & WHITE, Limited, 58 and 59, Bread-st, London, E.C. **See Advt., p. 620**

PYKE, HARRIS & CO, Limited, 33 and 34, New Tothill-st, Westminster, London, S.W.

Rainforth (W.) & Sons, Britannia Iron Works, Lincoln

Richards, Thomas Percival, 174, Beckenham-rd, Penge, S.E., and 3, Victoria-st, S.W., London

Robinson, Prof. William, University College, Nottingham

Robinson & Auden, Wantage, Berks.; and 47, Victoria-st, London, S.W. (R. Aylmer, Sole Agent)

Ross, Courtney & Co, 25, Ashbrook-rd, Upper Holloway, London, N.

Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on Tyne; and 5, Crown-court, Cheapside, London, E.C.

Selig, Sonnenthal & Co, 85, Queen Victoria-st, and Lambeth-hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7**

Sherborne Electric Installation, Sherborne, Dorset

Shorrock, J. & R., 60, Queen Victoria-st, London, E.C.; and Bolton-rd and Lee Foundries, Darwen, Lancs.

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump ail, Croydon, and Cromwell Iron Works, Croydon

TAYLOR, WILLIAM F., Boswell Court, Croydon

Tooley (Henry) & Co, Limited, Times Works, 63, Weaman st, Birmingham

URQUHART & SMALL, 17, Victoria-st, London, S.W.

Weeks (W.) & Son, Limited, Perseverance Iron Works, Maidstone

Whessoe Foundry Company, Limited, Whessoe, Darlington; and 28, Queen-st, London, E.C.

Whiteley (John) & Sons, Limited, Brunswick Mills, Halifax

WILLANS & ROBINSON, Limited, Ferry Works, Thames Ditton, Surrey; and 3, York-st, Lambeth, London, S.E. **See Advt., p. 555**

Yates & Thom, Canal Works, Blackburn

Young (H.) & Co, Eccleston Iron Works, Pimlico, London, S.W.

YOUNGS, Ryland-street Works, Birmingham

ENGINEERS (MINING).

ASKHAM BROS. & WILSON, Limited, Yorkshire Steel and Engineering Works, and Crucible Steel Foundry, Sheffield

Bewick, Moreing & Co, Broad-st House, New Broad st, London, E.C.

Bowes-Scott & Co, 9, Bridge-st, Westminster, London, S.W.

Chester (Edward) & Co., 23, Bucklersbury, London, E.C.

CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**

GOOLDEN (W. T.) & CO, Woodfield Works, Harrow-rd, London, W.

Howell, J. C., 24, Queen Victoria-st, London, E.C.; and Llanelly, South Wales

Snell, Albion T., Suffolk House, Cannon-st, E.C., and Brightside, Salusbury-rd, Brondesbury, N.W., London

Taylor, William F., Boswell Court, Croydon

ENGINEERS (VENTILATING).

Acme Ventilating and Heating Company, 35, Tarleton-st, Liverpool; and 13, King-st, Cheapside, London, E.C.

Æolus Waterspray Ventilating, Heating, Sanitary and Electrical Engineering Company 22, Bath-st, Glasgow; and 11, Queen Victoria-st, London, E.C.

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Aland & Co. 46, Commercial-rd. Lambeth, London, S.E.

ALLEN (W. H.) & CO, York-street Works, Lambeth, London, S.E. **See Advt., p. 37**

BLACKMAN VENTILATING CO, Limited, 63, Fore-street, London, E.C. (*Ventilator London. Telephone No. 512.*)

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Buchan, W. P., 36 and 38, Renfrew-st, Glasgow

BUMSTED & CHANDLER, Cannock Chase Foundry, Hednesford, Staffs. **See Advt., p. 13**

Erith (Chas.) & Co, 13, Little Trinity-lane, London, E.C.; and Manchester

Gibbs (Renton) & Co, Limited, 259 and 261, Mill-st, Liverpool; and at Birmingham

Humble, Stephen, 9, Victoria-st, London, S.W.

LAURENCE, SCOTT & CO, Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**

Lund Bros. & Co, 123 and 125, Oxford-st, London, W.

Pickup (J. H.) & Co, Limited, 64, Queen Victoria-st, London, E.C.

Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-court, Cheapside, London, E.C.

VERITY (B.) & SONS, 31 and 32, King-st, Covent Garden, W.C., and 137, Regent-st, W., London; Plume Works, Aston, Birmingham; and 29, Princes-st, Manchester

Weaver, R., C.E., F.C.S., 87, Oxford-st, London, W.

ENGINEERS' FURNISHERS.

BAGSHAWE BROS. & CO, 4A, Upper Thames st, London, E.C. **See Advts., pp. 606 and 617**

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570, and 572**

Croager Bros, Chatham Works, Homerton, London, N.E.

HATCH, GEORGE, Crown Wharf, 5, Upper Thames-st, London, E.C.

Phœnix Supply Company, 15, Hosier-lane, London, E.C.

Selig, Sonnenthal & Co, 85, Queen Victoria-st, and Lambeth-hill, London, E.C. **See Advt., pp. 4, 5, 6, and 7**

WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

WITTY & WYATT, Limited, 88, Leadenhall st, London, E.C.

YOUNGS, Ryland-street Works, Birmingham

ENGINEERS' TOOL MAKERS.

Archdale (James) & Co, Manchester Works, Ledsam-st, Birmingham

BAGSHAWE BROS & CO, 4A, Upper Thames-st, London, E.C. **See Advts., pp. 606 and 617**

Beardshaw (J.) & Son, Baltic Steel Works, Sheffield

Britannia Company, Colchester

Buck & Hickman, 280 and 281, Whitechapel-rd, and 1-7, Union-st, London, E.

Churchill (Charles) & Co, Limited, 21, Cross-st, Finsbury, London, E.C.; and 6, Albert-st, Birmingham

Cunliffe & Croom, Broughton Iron Works, Manchester

Dobie, John, 205, Argyle-st, Glasgow

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570, and 572**

Franklin (H.) & Co, 72-78, Gedling-st, London, S.E.

GLOVER (W. T.) & CO, Salford, Manchester; and 39, Victoria-st, London, S.W. **See Advt., p. 40**

Haigh & Co, Bowling Green Tool Works, Halifax

HATCH, GEORGE, Crown Wharf, 5, Upper Thames-st, London, E.C.

Herbert, Alfred, Coventry

Hood, Joseph, 9, Livery-st, and 2-16, Barwick-st, Birmingham

Leeson, J. E., Irlam, Manchester

Lister & Co, Beach Cliffe Works, Keighley, Yorks

Lupton, K. & H., Coventry

Mathieson (Alex.) & Son, Limited, Saracen Tool Works, East Campbell-st, Glasgow

Maud & Turner, Gibbet-st, Halifax, Yorks.

Muir (Wm.) & Co, Limited Sherbourne-st, Manchester

Osborn, Henry, 9, High-st, Southampton

Pearce Bros, 57, Crystal Palace-rd, Dulwich, London, S.E.

Pratt (F.) & Co, Halifax: and 11, Queen Victoria-st, London, E.C.

Ryan, G., 312, Euston-rd, London, N.W.

SELIG, SONNENTHAL & CO, 85, Queen Victoria-st, and Lambeth-hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7**

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

Taylor & Co, 247, Moston-lane, Blackley, Manchester

Wilkinson (G.) & Son, Keighley

Wilson (John) & Son, Vulcan Works, Johnstone, and 3, Oxford-st, Glasgow

Wild, Arthur M., 13, High-st, Sheffield

WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

YOUNGS, Ryland-street Works, Birmingham

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Collardon Company, 64, Strode-rd, Willesden Green, London, N.W.
DELLAGANA & CO, Limited, 106, Shoe-lane, and 48, Fetter-lane, E.C., and Gayton-rd, West Hampstead, N.W., London; and at Liverpool and Manchester **See Advt., p. 14**
GILKES' STEAM ENGRAVING WORKS, Reading, Berks. **See Advt. below**
Hare & Co, 31, Essex-st, Strand, W.C., and 7, Bride-ct, E.C., London
Swan Electric Engraving Company, 116, Charing Cross-rd, London, W.C.
Swain, John, 266, Strand, W.C., and 58, Farringdon-st, London, E.C.
VINTER, W., 3, Dyer's-bldgs, Holborn, London, E.C.

ENGRAVERS (INSTRUMENT).

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Matthews & Co, 19, Castle-st East, Oxford-st, London, W.
VINTER, W., 3, Dyer's-bldgs, Holborn, London, E.C.

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Cross, Harold G. E., Potterdale Works, Dewsbury-rd, Leeds
Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.
ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**
HANDLEY, ARTHUR, Messrs. D. & G. Graham, Clarence Works, Glasgow
NALDER BROS. & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 499**
NALDER & HARRISON, Trafalgar House, Great Newport-st, Charing Cross-rd, London, W.C. **See Advt., p. 523**
PYKE, HARRIS & CO, Limited, 33 and 34, New Tothill-st, Westminster, London, S.W.
Sherborne Electric Installation, Sherborne, Dorset
Tunzelmann, G. W. de, Electrical and General Engineering College, Penywern House, 2 and 4, Penywern-rd, Earl's Court, London, S.W. **See Advt., p. 461**

EXPERTS, ELECTRICAL.

Baily, F. B., M.A., University College, Liverpool
BENNETT, ALFRED ROSLING, 22, St. Alban's-rd, Harlesden, London, N.W.
CARTER, E. TREMLETT, Broadclyst, 53, Cloudesdale-rd, Upper Tooting, London, S.W.
Crompton, R. E. B., Messrs. Crompton & Co, Limited, Mansion House-bldgs, Queen Victoria-st, London, E.C.
Edmunds, Henry, Messrs. W. T. Glover & Co, 39, Victoria-st, London, S.W.
ESSON, W. B., Messrs. Johnson & Phillips, Victoria Works, Charlton, Kent
Fulton, T. Crichton, 74, Buchanan-st, Glasgow
LAURENCE, SCOTT & CO, Limited, Gothic Works, Norwich; and 116, Queen Victoria-st, London, E.C. **See Advt., p. 45**
MORGAN WILLIAMS & KING, 39, Victoria-st, London, S.W. (*Consonance London*)
Robinson, Prof., William, University College, Nottingham
Sisling, W. B., c/o Messrs. Laurence, Scott & Co, Limited, Gothic Works, Norwich; and Hamilton Drive, The Park, Nottingham
SLINGO & BROOKER, 65, Chelsham-rd, Clapham, London, S.W.
Snell, Albion T., Suffolk House, Cannon-st, E.C., and Brightside, Salusbury-rd, Brondesbury Park, N.W., London
SWINBURNE, JAMES, 4, Hatherley-rd, Kewgdns, London, S.W.
TAYLOR, WILLIAM F., Boswell Court, Croydon
Tunzelmann, G. W. de, Electrical and General Engineering College, Penywern House, 2 and 4, Penywern-rd, Earl's Court, London. **See Advt., p. 461**

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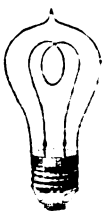

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Accordion Pleating Company, 17, Long-lane, E.C. ; and 228, Euston-rd, N.W., London
Baker (Richard), Son & Co, 6 and 7, Cross-lane, Eastcheap, London, E.C.
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Baxendale & Co, Miller-st, Manchester, and Edinburgh
Bergtheil & Young, 13, Walbrook, London, E.C. *See* "*Micanite.*"
Bowes, Alfred, Wild's Rents, 174, Weston-st, Bermondsey, London, S.E.
British and Colonial Mica Company, 11, Wardrobe Place, Queen Victoria-st, London, E.C.
BUTLER, F. A., East London Mica Works, 68, Grosvenor Park-rd, Hoe-st, Walthamstow, London, E. **See Advt., p. 469**

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Canadian Electrical Insulations Co, 78, Long-lane, London, E.C.
Davis (Edward) & Co, 2, Fen Court, Fenchurch-st, London, E.C.
Gates (R. H.) & Son, Victoria Mills, Fairclough-st, London, E.
Gerhardt, C. F., 34, Seething-lane, London, E.C.
Harrison (Wm.) & Co, 16, Mincing-lane, London, E.C.
Jaroslaw, D., 16, Water-lane, Great Tower-st, London, E.C.
Johnson, Charles, 140, Charing Cross-rd, W.C.
LAKE GIRARD MICA SYSTEM, 504, Besserer-st, Ottawa, Canada. **See Advt., p. 595**
Mica Company, 86, Leadenhall-st, London, E.C.
Rogers Bros, 221, Bradford-st, Birmingham
Selinger, Morris 8, Nicholas-st, Mile End-rd, London, E.
TANNAHILL (A.) & CO, 21, Mincing-lane, London, E.C.
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WAKE & SANDERS, 3, Crosby-st, Bishopsgate-st Within, London, E.C. **See Advts., pp. 470, &c.**
Wiggins (F.) & Sons, 10, Tower-hill, and 102, Minories, London, E.
Willing & Sons, Calvert-rd, Battersea, London, S.W.

Micanite.

BERGTHEIL & YOUNG, 13, Walbrook, London, E.C.
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Ozokerite.

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Paraffin Wax.

Baxendale & Co, Miller-st, Manchester; and Edinburgh
Bristow (Samuel Clay) & Co, 21, Great St. Helens, London, E.C.
Brockman (E.) & Co, 23, St. Mary-axe, London, E.C.
Broxburn Oil Company, Limited, 28, Royal Exchange, Glasgow; and Devonshire-chmbrs, Bishopsgate-st, London, E.C.

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Cooke (John) & Sons, 6, Oxford-ct, Cannon-st, London, E.C.
Mordan (Francis) & Co, 326, City-rd, London, E.C.
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Vulcanised Fibre.

DELAWARE HARD FIBRE COMPANY, Wilmington, Del, U.S.A, and 15, Long-lane, London, E.C. **See Advt., p. 576**
MOSSES & MITCHELL, 68 to 71, Chiswell-st, London, E.C. **See Advts. below, and p. 616**
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., page 1**

Vulcanite.

Britannia Rubber and Kamptulicon Company, 32, Cannon-st, London, E.C.
HARBURG INDIA RUBBER C. COMPANY, 138, London-wall, London, E.C. **See Advts., pp. 471, 576 and 642**
Hanover Vulcanite Company, Moorgate Station-bldgs, 63, Finsbury-pavement, London, E.C.
HAYESMOORE COMPANY, 53, Crewdson-rd, Clapham-rd, London, S.W.
MOSELEY (DAVID) & SONS, Chapel Field Works, Ardwick, Manchester; and at London and Glasgow. **See Advt. p, 56.**
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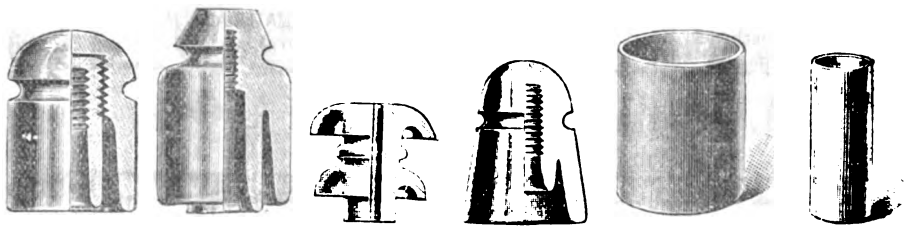

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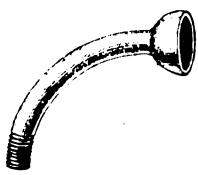

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GILKES' STEAM ENGRAVING WORKS, Reading, Berks. **See Advt., 565**

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IVORY TURNERS.

BATE, R., 39½, Leather-lane, London, E.C. **See Advt., 647**

BONNELLA (D. H.) & SON, 58, Mortimer-st, W., and 42 and 43, Kirby-st, Hatton-gdn, E.C., London. **See Advt., p. 647**

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Lawrance, W. J., 9, Giltspur-st, London, E.C.

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Groves (R.) & Sons, Beehive Works, Sheffield

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McOnie, Harvey & Co, Limited, 224, West-st, Glasgow

Newbold (Walter) & Co, 1A, Laurence Pountney-hill, London, E.C.

Pearce. Bros., 57, Crystal Palace-rd., East Dulwich, London, S.E.

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Spear & Jackson, Ætna Works, Sheffield; and 22, Queen-st, London, E.C.

Taylor, Charles, Bartholomew-st, Birmingham

Tomlin, J., Queen's-rd, Barnsley, Yorks.

WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

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(*See also* **Electric Cables.**)

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FOWLER-WARING CABLES COMPANY, Limited, 4, Victoria-mansions, 32, Victoria-st, London, S.W.; and North Woolwich. **See Advts., pp. 302 and 475**

GLOVER (W. T.) & CO, Salford, Manchester; and Albany-bldgs, 39, Victoria-st, London, S.W. **See Advt., p. 40**

SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**

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BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st., E.C., and 112, Belvedere-rd, S.E., London

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BEREND (O.) & CO, 61, Fore-st, London, E.C. *(Yttrium London)*

ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**

KING, MENDHAM & CO, Narrow Wine and Fairfax-sts, Bristol; and 12, Fenchurch-st, London, E.C.

Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

Sherborne Electric Installation, Sherborne, Dorset

SPAGNOLETTI & CROOKES, Goldhawk Works, 39A, Goldhawk-rd, London, W.

LECTURERS, TEACHERS AND DEMONSTRATORS.

(See also **Universities, Schools, Colleges, &c.,** *pp. 264 to 273)*

Atkins, H. C., Lecturer on Electrical Engineering and Applied Electricity in the Birmingham Municipal Technical School

Bagnold, Arthur Henry, Major R.E., Instructor in Electricity at the School of Military Engineering, St. Mary's Barracks, Chatham

Baily, F. G., M.A., University College, Liverpool

Beare, T. Hudson, Engineering Laboratory, University College, Gower-st, London, W.C.

Burch, George J., B.A., University Extension College, Reading, Chemistry and Physics.

CARTER E. TREMLETT, Broadclyst, 53, Cloudesdale-rd, Upper Tooting, London, S.W.

Clifton, Robert Bellamy, F.R.S., Clarendon Laboratory, Oxford.

Dale, E. R., Greenhill, Sherborne, Dorset

Fulton, T. Crichton, A.I.E.E., 74, Buchanan-st, Glasgow. (Assistant to the Professor of of Electrical Engineering, The Glasgow and West of Scotland Technical College)

Grove, Charles E., Blackwall Iron Works, London, E.

Joyce, Samuel, jun., Manchester Technical School, Manchester

Maddox, A. J., City of London Young Men's Christian Association, 186, Aldersgate-st, London, E.C.

Maycock, W. Perren, 26, Stafford-rd, Croydon

McMichael, John A., B.A., Grosvenor Museum, Chester (Lecturer on Magnetism and Electricity, School of Science and Art and Technical Schools)

Mundella, V. A., Durham College of Science, Newcastle-on-Tyne

Searle, G. F. C., Cavendish Laboratory, Cambridge

Skirrow, B. B., M.A., Municipal Technical School, Manchester.

Tunzelmann, G. W. de, Electrical and General Engineering College, Penywern House, 2 and 4, Penywern-rd, Earl's Court, London, S.W. **See Advt., p. 461**

Wannell, Mrs. P., 41, Camden-road, London, N.W.

Wells, Sidney H., Wh.Sc., Battersea Polytechnic Institute, Battersea, London, S.W.

Whitehouse, W. A., Municipal Technical School, Manchester

Wilson, W., M.A., Merchant Venturers' School, Bristol

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Curtis-Hayward, A. C., 27, Chancery-lane, London, W.C.

Morse, Sydney, 4, Fenchurch-avenue, London, E.C.

Tunzelmann, G. W. de, Electrical and General Engineering College, Penywern House, 2 and 4, Penywern-rd, Earl's Court, London, S.W. **See Advt., p. 461**

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Newbold (Walter) & Co, 1A, Lawrence Pountney-hill, London, E.C.

Selig, Sonnenthal & Co, 85 Queen Victoria-st, and Lambeth Hill, London, E.C. **See Advts., p 4, 5, 6, and 7**

WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

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Chance Bros & Co, near Birmingham

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Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.

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BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, Lambeth, S.E., London

Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**

MUIRHEAD & CO, 2, Princes-st, Great George-st, London, S.W. **See Advt., p. 521**

Telegraph Manufacturing Company, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.

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WESTINGHOUSE ELECTRIC COMPANY, Limited, 32, Victoria-st, London, S.W. **See Advt., p. 487**

LIGHTNING CONDUCTORS (Makers and Contractors for the Erection of).

Anderson (R.) & Co, 101, Leadenhall-st, London, E.C.

Ball, Joseph, York Castle, Oldham

BARTON, THOMAS, Electric Works, Blackburn (*Barton Blackburn, 265*)

Baxendale & Co, Miller-st, Manchester; and Edinburgh

BENHAM & FROUD, Limited, 40, Chandos-st, Strand, London, W.C.

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

Binks Bros, Strafford-st, Millwall, London, E.

Blackburn, Joseph, 39, Arkwright-st, and Gresham Works, Nottingham

Brown (W. B.) & Co, Globe Works, Bankhall, Liverpool

Bryden (John) & Sons, 60, Renfield-st, Glasgow; and 90, Gloucester-rd, London, S.W.

Bullivant & Co, 72, Mark-lane, E.C., and 38, West Ferry-rd, Poplar, E., London

Burns, Joseph, 27, Whitevale-st, Glasgow (Fitter)

Callahan, W., 183, Allander-st, Possilpark, Glasgow (Fitter)

CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**

Corlett Electrical Engineering Company, Limited, Rowbottom-sq, Wigan; and Breightmet-st, Bolton

Croggon & Co, Limited, 16, Upper Thames-st, London, E.C.; 19, Tithebarn-st, Liverpool; and 7, John-st, Glasgow

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DENNIS (W. F.) & CO (Agents for Felten & Guilleaume), 11, Billiter-st, London, E.C. **See Advt., p. 9**

Ellis (E.) & Co, 21, Emmett-st, Poplar, London, E.

Faulkner, John, 13, Great Ducie-st, Strangeways, Manchester; and at Belfast

Finlay (John) & Co, 18, Renfield-st, and Overnewtown Works, Glasgow

GLOVER (W. T.) & CO, Salford, Manchester; and 39, Victoria-st, London, S.W. **See Advt., p. 40**

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Haggie Bros, Gateshead-on-Tyne; and 113, Fenchurch-st, London, E.C.

HAGGIE (R. HOOD) & SON, Queen-st, Newcastle-on-Tyne

Harrison, W. E., Steeplejack Works, Sheffield

Hart, Son, Peard & Co, Limited, 88 to 91, Drury-lane, Strand, London, W.C.; and Grosvenor Works, Birmingham

Jenkins (W.) & Son, 36, Parade, Leamington

JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C., and Victoria Works, Charlton, Kent. **See Advt., p. 3**

Laidler, Thomas, 1, Lee-st, Thomas-st, Limehouse, London, E.

Lamb (Joseph P.) & Co, 24, Canning-place, and Wolstenholme-sq, Liverpool

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MANCHESTER EDISON-SWAN COMPANY, Limited, Temple-chmbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**

MIDLAND WIRE CORDAGE COMPANY, Vincent-st, Balsall Heath, Birmingham

Morris & Gold, Wardrobe Chambers, Queen Victoria-st, London E.C.

Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

Newall (R. S.) & Son, Limited, 117, Leadenhall-st, London, E.C.; and Washington, Durham

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Tosh (David) & Son, 77, Queen-st, Glasgow; and 3 and 11, Brougham-st, Greenock

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SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W.; and Woolwich. **See Advt. inside front cover**

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LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, 64, Millbank-st, S.W., and 11, Abchurch-lane, E.C., London. **See Advt., p. 602**
MANCHESTER EDISON-SWAN COMPANY Limited, Temple-chmbrs, 29, Brazennose-st, Manchester. **See Advt., p. 10**
Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.
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Whittaker & Co, 85, Queen Victoria-st, London, E.C.

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KÜCKE & CO, Elberfeld, Germany. **See Advt., p. 541** (No agents)

LOCAL AUTHORITIES AND THEIR OFFICIALS.

(*See pages 234—252.*)

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Barrett, Tagant & Pochin, Corrisson Works, Fulham, London, S.W.
Bluman & Stern, Limited, Batoum Wharf, Odessa-st, Rotherhithe, S.E., and 43, London-wall, E.C., London.
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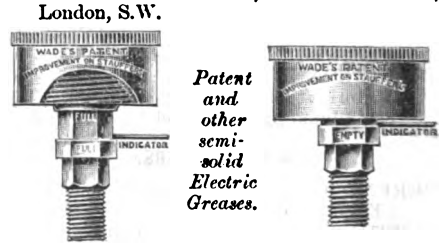

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(*See also* **Driving Band Makers.**)

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SAMPSON & CO, Stroud. **See pp. 410 and 467**
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Hemans (Henry) & Co, 35, Queen Victoria-st, London, E.C.
HOWES, SIMEON, 64, Mark-lane, London, E.C. **See Advt., p. 639**
Machinery Purchase Hire Company, 46, Queen Victoria-st, London, E.C.
Phillips, Chas. D., Newport, Mon., and Gloucester
Priestley, William, Southgate-st, Gloucester
SELIG, SONNENTHAL, & CO, 85, Queen Victoria-st, and Lambeth-hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7**

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SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**
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PATERSON & COOPER, European Works, Pownall-rd, Dalston, N.E., and 3, Princes-mansions, Victoria-st, S.W., London ; and 137, West Regent-st, Glasgow. **See Advt., p. 39**
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(*See also* **Scientific Instrument Makers.**)

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BARKER (FRANCIS) & SON, 12, Clerkenwell-rd, London, E.C. **See Advt., p. 462**
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DAVIS (J.) & SON, All Saints' Works, Derby ; and 118, Newgate-st, London, E.C.
ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**
Eyre & Spottiswoode, Great New-st, London, E.C.
Gent, Frank E., 96, Rosoman-st, Clerkenwell, London, E.C.
Green, W., 5, Mount Pleasant, Clerkenwell, London, E.C.
Harling, W. H., 47, Finsbury-pavement, London, E.C.
Harris, W. J., 91, Shadwell-st, Birmingham

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NALDER BROS. & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 499**
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Stanley, W. F., 4 and 5, Great Turnstile, Holborn, W.C., and 8, Victoria-st, S.W., London
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Wray, W., North-hill, Highgate, London, N.

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(*See also* **Batteries, Makers of.**)

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Martin, W. W., Worcester Cross, Kidderminster
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Beardmore (Wm.) & Co, Parkhead Forge and Steel Works, Glasgow
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Dewrance & Co, 158, Great Dover-st, London, S.E.
DUTTON & CO, Limited, Railway Signal Works, Worcester; and 70 and 71, Palace-chambers, Westminster, London, S.W.
Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.
EVERED & CO, Limited, 27-31, Drury-lane, W.C., 143, High-st, Shoreditch, E., and 50, Holborn-viaduct, E.C., London; and Surrey Works, Smethwick. **See Advt., p. 38**
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Harper (J.) & Co, Albion Works, Willenhall; and 133 and 135, Finsbury-pavement, London, E.C.
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Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.
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Taylor Bros. & Co, Clarence Iron and Steel Works, Leeds; and 16, Victoria-st, London, S.W.

METAL EXPANDERS.

British Metal Expansion Company, Limited, Stranton Works, West Hartlepool; and 3, Lambeth-hill, Queen Victoria-st, London, E.C. (*Expansion West Hartlepool*)

METAL MANUFACTURERS AND FOUNDERS.

General.

Anti-Attrition Metal Company, Emerson-st, Southwark, London, S.E. (Bearings)
Barrett (R.) & Son, Limited, King's Head-ct, Beech-st, London, E.C.
Bodill, Parker & Co, Limited, Albion Works, Great Hampton-row, Birmingham
Butterley Company, Limited, near Derby; and 118, Cannon-st, London, E.C.
Elliott's Metal Company, Limited, Pembrey Copper Works, Burry Port, South Wales; Selly Oak, near Birmingham; and London, Liverpool, Manchester, and Glasgow
EVERED & CO, Limited, 27-31, Drury-lane, W.C., 143, High-st, Shoreditch, E., and 50, Holborn-viaduct, E.C., London; and Surrey Works, Smethwick. **See Advt., p. 38**
Everitt (Allen) & Sons, Limited, Kingston Metal Works, Adderley-st, Birmingham; and 118, Cannon-st, London, E.C.
Falkirk Iron Company (R. W. Kennard & Co), 67, Upper Thames-st, London, E.C.; and Liverpol, Glasgow and Edinburgh. Works: Falkirk, N.B.
Fossick & Co, Limited, 86, Cannon-st, London, E.C.
Guthrie (J. B.) & Son, 70 and 71, Bishopsgate-st Within, London, E.C.
Hall, William, 87 & 89, Winstanley-rd, Battersea, London, S.W.
HATCH, GEORGE, Crown Wharf, 5, Upper Thames-st, London, E.C.
Höveler & Dieckhaus, 3, Stockwell-avenue, London, S.W.
HOWES, SIMEON, 64, Mark-lane, London, E.C. **See Advt., p. 639**
PHOSPHOR BRONZE COMPANY, Limited, 87, Sumner-st, Southwark, London, E.C.; and Wire and Sheet Mill, Bagot-st, Birmingham. **See Advt., p. 438**
Pyrites Company, Limited, Cornhill Chambers, 63, Cornhill, London, E.C.
Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.
SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon
Turner & Co, 1, George-st, Lisson-grove, London, N.W.

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Aluminium.

Aluminium Company, Ltd, 13 and 14, Abchurch-lane, London, E.C.; and Oldbury, near Birmingham

Cowles (Aluminium) Syndicate Company, Limited, Milton Works, Milton, near Stoke-on-Trent, Staffs.

Merton (H. R.) & Co, 2, Metal Exchange-bldgs, Whittington-avenue, London, E.C.; and 39A, New-st, Birmingham

Phœnix Metal Die and Engineering Company, Limited, 40, Coin-st, Stamford-st, London, S.E.

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

Van Wart, Leighton & Co, 110, Cannon-st, London, E.C.

Brass.

Baxendale & Co, Miller-st, Manchester; and Edinburgh

Blundell's London Copper and Brass Works, Limited, West India Dock-rd, London, E.

Bowen & Co, 6, Mount Pleasant, Clerkenwell, London, E.C.

Brent (G.) & Son, 45, Upper East Smithfield, and 94, West India Dock-rd, London, E.

DUTTON & CO, Limited, Railway Signal Works, Worcester; and 70 and 71, Palace-chambers, Westminster, London, S.W.

Hunt & Mitton, Oozells-st North, Birmingham

Manganese Bronze and Brass Company, Limited, 73, Lombard-st, E.C., and St. George's Wharf, Deptford, S.E., London

Pontifex & Wood, Limited, Derby; and 34, New Bridge-st, London, E.C.

Scrap Metal Company, 138, Palmerston-bldgs, London, E.C.

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

Van Wart, Leighton & Co, 110, Cannon-st, London, E.C.

Wailes (George) & Co, 258, Euston-rd, London, N.W.

Bronze.

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

Van Wart, Leighton & Co, 110, Cannon-st, London, E.C.

Copper.

Baxendale & Co, Miller-st, Manchester; and Edinburgh

Brent (G.) & Son, 45, Upper East Smithfield, and 94, West India Dock-rd, London, E.

Broughton Copper Company, Limited, Manchester; and 122, Cannon-st, London, E.C.

Espir, Fernand, 3, East India-avenue, London, E.C. (Agent for Messrs. Lazare Weiller & Co. **See Advts. in Continental Division.**)

PHOSPHOR BRONZE COMPANY, Limited, 87, Sumner-st, Southwark, London, S.E.; Bagot-st, Birmingham; and Etruria, Hanley. **See Advt., p. 438**

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

Val d'Aosta Syndicate, Limited, Mansion House-bldgs, Queen Victoria-st, London, E.C.

Van Wart, Leighton & Co, 110, Cannon-st, London, E.C.

Williams, Foster & Co. and Pascoe, Grenfell & Sons, Limited, Morfa and Middlebank Copper Works, Swansea; and Leadenhall-bldgs, London, E.C.

German Silver.

PHOSPHOR BRONZE COMPANY, Limited, 87, Sumner-st, Southwark, London, S.E.; Bagot-st, Birmingham; and Etruria, Hanley. **See Advt., p. 438**

RAMSDEN, CAMM & CO, Brighouse, Yorks. **See Advt., p. 10**

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

Iron.

Abbott (John) & Co, Limited, Park Works, Gateshead-on-Tyne; and Suffolk House, Laurence Pountney-hill, London, E.C.

BEESLEY (W. T.) & CO, Limited, Attercliffe-rd and Effingham-st, Sheffield. **See Advt., p. 618**

BUMSTED & CHANDLER, Cannock Chase Foundry and Engine Works, Hednesford, Staffs. **See Advt., p. 13**

DAVEY, PAXMAN & CO, Standard Iron Works, Colchester; and 78, Queen Victoria-st, London, E.C. **See Advt., p. 51**

Dorman, Long & Co, Limited, Middlesbrough; and 19, Victoria-st, London, S.W.

DUTTON & CO, Limited, Railway Signal Works, Worcester; and 70 & 71, Palace-chambers, Westminster, London, S.W.

Falkirk Iron Company (R. W. Kennard & Co), 67, Upper Thames-st, London, E.C.; and Liverpool, Glasgow, and Edinburgh. Works: Falkirk, N.B.

Graham (William) & Sons, Trig-lane and Castle-yard, Upper Thames-st, London, E.C.; and at Birmingham

Horseley Company, Limited, 11, Victoria-st, London, S.W.; and at Tipton, Staffs

Knight & Crowther, Limited, Kidderminster and Brierley Hill

Lucas (Edward) & Son, Dronfield Foundry, near Sheffield

Macfarlane (Walter) & Co, Saracen Foundry, Possilpark, Glasgow

Measures Bros., Limited, 57, Southwark-st, and Bankside, London, S.E.

Monks, Hall & Co, Limited, Warrington; and 70 and 71, Bishopsgate-st Within, London, E.C.

Moser & Sons, 178, 182, and 192, Borough High-st, London, S.E.

Pfeil, Stedall & Son, 3 & 6, Broad-st, Bloomsbury, London, W.C.

Ransome (A.) & Co, Limited, Stanley Works, King's-rd, Chelsea, and Battersea Foundry, Wellington-rd, Battersea, London, S.W.

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Reed (Chas. H.) & Co, Trindon Iron Works, Sunderland
SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon
Walmsley (T.) & Sons, Atlas Iron Works, Bolton

Lead.

Baxendale & Co, Miller-st, Manchester; and Edinburgh
Cookson & Co, Newcastle-on-Tyne
Farmiloe, T. & W., 19, 21 and 23, Rochester-row, Westminster, and 88, Nine Elms-lane, S.W., and Island Lead Mills, Limehouse, E., London
Grey & Marten, City Lead Works, New Park-st, Southwark Bridge, London, S.E.
SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon.

Manganese Bronze.

Manganese Bronze and Brass Company, Limited, 73, Lombard-st, E.C., and St. George's Wharf, S.E., London

Phosphor Bronze.

Billington & Newton, Vulcan Metal Works, Longport, Staffs.
BUMSTED & CHANDLER. Cannock Chase Foundry and Engine Works, Hednesford, Staffs. **See Advt., p. 13**
Dewrance & Co, 153, Great Dover-st, London, S.E.
PHOSPHOR BRONZE COMPANY, Limited 87, Sumner-st, Southwark, London, S.E.; Bagot-st, Birmingham; and Etruria, Hanley. (Phosphor Bronze Alloys and Wire) **See Advt., p. 438**
SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon
YOUNGS, Ryland-st Works, Birmingham

Platinum and Platina.

Jamieson, W. & J., 10, Broad-st, Golden-sq, London, W.
Johnson, Matthey & Co, Hatton-garden, London, E.C.
Johnson & Sons, Limited, 23, Cross-st, Finsbury, London, E.C.

Silicium Bronze.

PHOSPHOR BRONZE COMPANY, Limited, 87, Sumner-st, Southwark, London, S.E.; Bagot-st, Birmingham; and Etruria, Hanley. **See Advt., p. 438**

Spelter.

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

Steel.

ASKHAM BROS. & WILSON, Limited, Yorkshire Steel and Engineering Works, and Crucible Steel Foundry, Sheffield
BAGSHAWE BROS. & CO, 4A, Upper Thames-st, London, E.C. **See Advts., pp. 606 and 617**
Beardshaw (J.) & Son, Baltic Steel Works, Sheffield
BEESLEY (W. T.) & CO, Limited, Attercliffe-rd and Effingham-st, Sheffield. (*Beesley Sheffield*) **See Advt., p. 618**
Bolton Iron and Steel Company, Limited, Bolton-le-Moors, Lancs.; and 38 Parliament-st, London
Bosher (A. B.) & Co, Carbon Works, St. George's-sq., Sheffield
Brown Bayley's Steel Works, Limited, Sheffield; and 1, Queen Victoria-st, London, E.C.
Brymbo Steel Co, Brymbo, near Wrexham
Hadfield's Steel Foundry Company, Limited, Hecla Works, Sheffield: and 156 and 157, Leadenhall-st, London, E.C.
Harvey Steel Co, of Great Britain, Ltd, 28, Victoria-st, London, S.W.
HATCH, GEORGE, Crown Wharf, 5, Upper Thames-st, London, E.C.
Ibbotson Bros & Co, Globe Iron Works, Sheffield; and at Liverpool and London
Knight & Crowther, Limited, Kidderminster and Brierley Hill
Lysaght, John, Limited, St. Vincent Works, Bristol; 36, Gracechurch-st, London, E.C.; and at Wolverhampton
Otis Steel Company, Limited, 20, Threadneedle-st, London, E.C.
Ramshay & Marshall, 17, Lime-st, London, E.C.

Tin.

Baxendale & Co, Miller-st, Manchester; and Edinburgh
Knight & Crowther, Limited, Kidderminster and Brierley-hill
PHOSPHOR BRONZE COMPANY, Limited, 87, Sumner-st, Southwark, London, S.E.; Bagot-st, Birmingham; and Etruria, Hanley. **See Advt., p. 438**
SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

Tin and Lead Foil.

Baxendale & Co, Miller-st, Manchester; and Edinburgh
Betts & Co, Wharf-rd, City-rd, and Elthorn-rd, Upper Holloway, London, N.
Knight & Crowther, Limited, Kidderminster and Brierley-hill
Quirk, Barton & Co, 9, Gracechurch-st, London, E.C.

Zinc.

Baxendale & Co, Miller-st, Manchester; and Edinburgh
Braby (Fredk.) & Co, Limited, 352 to 362, Euston-rd, London, N.W.
London Zinc Mills, Limited, Wenlock-rd, London, N.

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METAL MERCHANTS.

General.

Ashby, Morris, Limited, 17, Laurence Pountney-lane, London, E.C.
AUTOMATIC STANDARD SCREW COMPANY, Halifax **See Advts., pp. 611 and 634**
Bastin & Lawson, 49, Finsbury-pavement, London, E.C.
Baxendale & Co, Miller-st, Manchester; and Edinburgh
Bradley & Burch, Leadenhall-bldgs, Leadenhall-st, London, E.C.
BENNETT, WALTER, 60, Gracechurch-st, London, E.C.
BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Aluminium "Tempered," Copper "Tempered," Iridium, Platinum, Silicon, Tungsten, Chrome, Rare Metals
Campbell, McMaster & Co, Botolph-house, 10, Eastcheap, London, E.C.
EVERED & CO, Limited, 27-31, Drury-lane, W.C., 143, High-st, Shoreditch, E., and 50, Holborn-viaduct, E.C., London; and Surrey Works, Smethwick. **See Advt., p. 38**
Eyre (W.) & Nephew, Manchester-bldgs, 1, Tithebarn-st, Liverpool
Farwig & Johnson, 5, Lime-st, and 26, Upper Thames-st, London, E.C.
HATCH, GEORGE, Crown Wharf, 5, Upper Thames-st, London, E.C.
Hughes, Chemery & Co, 118, Bishopsgate-st, Within, London, E.C.
Norton (Wm.) & Co, 190, Gresham House, London, E.C.
Pullen, F. A., 1, Church-ct, Clement's-lane, London, E.C.
Sayer, Henry J., 21 and 22, Cambridge-st, Birmingham
Wolff (R.) & Co, 12, Fenchurch-st, London, E.C.
WILLCOX (W. H.) & CO. 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1.**

Aluminium.

Allan (George) & Co, 10, Austin-friars, London E.C.
BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
BRABY (F.) & CO., Limited, 352 to 364, Euston-rd, N.W.; 118 & 120, High-st, Borough, S.E.; and 110, Cannon-st, E.C., London; 47 & 49, St. Enoch-sq, Glasgow; and Hatton-gdn., Liverpool
Van Wart, Leighton & Co, 110, Cannon-st, London, E.C.

Brass.

Baxendale & Co, Miller-st, Manchester; and Edinburgh
Espir, Fernand, 3, East India-avenue, London, E.C. (Speciality of French Screw Brass Rodding)
Maples, G. A., 222, Walworth-rd, London, S.E.
Smith (John) & Sons, St. John's-sq, Clerkenwell, London, E.C.

Copper.

Baerlein & Co, 12, Blackfriars-st, Salford, Manchester; and Liverpool and London
Baxendale & Co, Miller-st, Manchester; and Edinburgh
Corry, Edward, 9, New Broad-st, London, E.C.
Espir, Fernand, 3, East India-avenue, London, E.C. (Agent for Messrs. **Lazare**, Weiller & Co. **See Advts. in Continental Division**)
GLOVER (W. T.) & CO., Salford, Manchester; and 39, Victoria-st, London, S.W. **See Advt., p. 40**
Logan & Co., Copper Wharf, Birkenhead
New Panulcillo Limited, 3, Great Winchester-st, London, E.C.
Needham (John) & Sons, 13, Cannon-st, Manchester
Schwann & Co, 6, Moorgate-st, London, E.C.

Delta Metal.

Delta Metal Company, Limited, 110, Cannon-st, E.C., and 29, Pomeroy-st, New Cross-rd, S.E., London

Iron.

Bailey, Pegg & Co, 81, Bankside, Southwark, London, S.E; and Brierley Hill, Staffs.
Baxendale & Co, Miller-st, Manchester; and Edinburgh
Carson (F. M.) & Co, 6, Fenchurch-bldgs, London, E.C.
James (John) & Son, 21, Lime-st, London, E.C.
Sayer, H. J., 21 and 22, Cambridge-st, Birmingham

Lead.

Baxendale & Co., Miller-st, Manchester; and Edinburgh
Dickson & Head, 80 and 81, St. George's-st, and 3, Ratcliff-st, London, E.
Farmiloe, T. & W., 19, 21, and 23, Rochester-row, Westminster, London, S.W.

Manganese.

BAILEY (S. G.) & CO, Stafford Mills, Stroud, Gloucestershire
Birch (J.) & Co, Limited, 40, Chapel-st, Liverpool; and 10 and 11, Queen-st-place, London, E.C.
Blackwell, (G. G.), Sons & Co., 25 to 27, Irwell-chmbrs, Fazakerly-st, Liverpool; and 4, Billiter-bldgs, London, E.C.
Gilbert, W. K., 6, Dowgate-hill, London, E.C.
Haeberlin, J. F., 1, Whittington-avenue, Leadenhall-st, London, E.C.
MacQueen Bros, 11, Old Jewry-chmbrs, London E.C.
Parkyn & Peters, 32, Queen Victoria-st, London, E.C.; and St. Austell, Cornwall

Nickel.

Nickel Company, Erdington, near Birmingham. (H. R. Merton & Co, Agents)

Platinum.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Derby & Co, 44, Clerkenwell-rd, London, E.C.
Jamieson, W. & J., 10, Broad-st, Golden-sq, London, W.
Robertson (J. W.) & Co, 100, Aldersgate-st, London, E.C.
Westwood, Chas., 53, Great Hampton-st, Birmingham

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Spelter.

BENNETT, WALTER, 60, Gracechurch-st, London, E.C.
Braby (F.) & Co, Limited, 352 to 364, Euston-rd, N.W., 118 and 120, High st, Borough, S.E., and 110, Cannon-st, E.C., London; 47 and 49, St. Enoch-sq, Glasgow; and Hatton-garden, Liverpool
English Crown Spelter Co, Limited, 9, Queen-st Place, London, E.C.
Niblett, George D., Hertford Wharf, Hertford-rd, Kingsland, London, N.
Overweg, Chas., 9, New Broad-st, London, E.C.

Tin.

Baxendale & Co, Miller-st, Manchester; and Edinburgh
Erhardt (H.) & Co, 9 and 10, Bond Court, Walbrook, London, E.C.

Zinc.

Banks, B. R., 21 and 31, Deptford-broadway, and 1, Watson-st, New Cross, London, S.E.
Baxendale & Co, Miller-st, Manchester; and Edinburgh
Borton, Henry, 130, High-st, Ramsgate, and 316, Bethnal-green-rd, London, E.
Braby (F.) & Co, Limited, 352 to 364, Euston-rd, N.W., 118 and 120, High-st, Borough, S.E., and 110, Cannon-st, E.C., London; 47 and 49, St. Enoch-sq, Glasgow; and Hatton-garden, Liverpool
Dandridge, J. & A., 15, Church-st, Deptford, London, S.E. (Old Zinc)
Frank, T., 8, Bush-lane, London, E.C.
London Zinc Mills, Limited, Wenlock-rd, London, E.C.
Pailthorpe & Krellwitz, 40 and 41, Upper Thames-st, London, E.C.
Petrie & Gardiner, 3 and 4, Lime-street-sq, London, E.C.

METAL (OLD AND SCRAP) MERCHANT.

BENNETT, WALTER, 60, Gracechurch-st London, E.C.

METAL MOULDERS.

Baxendale & Co, Miller-st, Manchester; and Edinburgh

METAL POLISHERS.

Baxendale & Co, Miller-st, Manchester; and Edinburgh
STURTEVANT, T. T., 92, Clerkenwell-rd, London, E.C. **See Advt., p. 596**

METAL REFINERS.

(*See also* **Nickel Platers and Refiners.**)

Blundell, John, 162, Wardour-st, London, W. (Gold and Silver)
Collingridge Bros., 60 and 62, Clerkenwell-rd, London, E.C.
Crook, Walter J., 35, Eastcheap, London, E.C.
Desmoutis (F.), Lemaire & Co, 247, Tottenham Court-rd, London, W.C. (Platinum)
Domeier & Co, 13, St. Mary-at-Hill, London, E.C.
Fuerst Bros, 17, Philpot-lane, London, E.C. (Antimony)
Hallett & Fry, 202, Rotherhithe-st, London, S.E.
Johnson, Matthey & Co, Ltd, Hatton-gdn, E.C.
Lixa Mining Company, Limited, 6, Great St. Helen's, London, E.C. (Antimony)
Pratt (J. J.) & Son, 79, Queen-st, E.C., and 305, Kingsland-rd, N.E., London. (Antimony)
Sheffield Smelting Company, Limited, 3, Cross-st, Clerkenwell-rd, London, E.C. (Platinum)
Sheffield Wire Company, Sylvester-gdns, Arundel-st, Sheffield. (Steel)

METAL SHADES AND REFLECTORS, MAKERS OF.

(*See also* **Reflectors and Shades.**)

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Every size and material made to order
DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocers' Hall-ct, London, E.C. **See Advt., p. 11**
Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C. London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570, and 572**
Falkirk Iron Company (R. W. Kennard & Co), 67, Upper Thames-st, London, E.C.; and Liverpool, Glasgow, and Edinburgh. Works: Falkirk, N.B.

METAL SHAPERS.

SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

METAL SPINNERS.

BENHAM & FROUD, Limited, 40, Chandos-st, Strand, London, W.C.
BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Browett & Co, 14, Dean-st, Birmingham
Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.
Still (W. M.) & Co, 24, Charles-st, Hatton-gdn, London, E.C.

METAL STAMPERS.

Brampton (F.) & Co, Oliver-st Works, Birmingham
Edwards & Barnes, 237, Broad-st, Birmingham
Lansard & Co, 216, Goswell-rd, London, E.C.
Sankey (Joseph) & Sons, Albert-st Works, Bilston, Staffs.; and 88, Bishopsgate-street Within, London, E.C.

METAL WORKERS.

Ash (Joseph) & Son, Rea-st, South Birmingham
Baxendale & Co, Miller-st, Manchester; and Edinburgh
BENHAM & FROUD, Limited, 40, Chandos-st, Strand, London, W.C.
Earle, Bourne & Co, Birmingham Tube Works and Rolling Mills, Heath-st South, Spring Hill, Birmingham

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Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570, and 572**
Escaré, Maurice, 15, Store-st, London, W.C.
EVERED & CO, Limited, 27-31, Drury-lane, W.C., 143, High-st, Shoreditch, E., and 50, Holborn-viaduct, E.C., London; and Surrey Works, Smethwick. **See Advt., p. 38**
Expanded Metal Company, Limited, 2, Dean's-yd, Westminster, London, S.W.
Farringdon Works, Limited, Shoe-lane, London, E.C.
HARRIS (A. & E.) & CO, 95, Camden-st, Birmingham
Hasler (Charles) & Son, 94, Bridge-street West, Birmingham
Nunn, Wm. & A., 173, Shadwell High-st, London, E.
SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon
St. Pancras Ironwork Company, 171 - 173, Pancras-rd, London, N.W.
Tucker Bros, Esher-st, Kennington, London, S.E.
Udal, Sons & Symonds, Birmingham

METALLURCISTS (*see* **Electro-Metallurgists**).

METEOROLOGICAL INSTRUMENT MAKERS.

(*See also* **Scientific Instrument Makers.**)

DAVIS (J.) & SON, All Saints' Works, Derby; and 118, Newgate-st, London, E.C.
ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**
Smith (S.) & Son, 9, Strand, London, W.C.

METER DIALS, WORKS AND TRAINS, MAKERS OF.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
FERRANTI (S. Z., DE) Limited, St. Benet-chmbrs, Fenchurch-st, and 27, Charterhouse-sq, London, E.C. **See Advt. on next page**
SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon

METERS (ELECTRIC), MAKERS OF.

(*See also* **Electricity Meters.**)

ANDERS' TELEPHONE COMPANY, Limited, Telephone-bldgs, 31, Queen Victoria-st, London, E.C. **See Advt., p. 630**
Hookham—Chamberlain & Hookham, Limited, 4, New Bartholomew-st, Birmingham
CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**
CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London; Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover.**
DRAKE & GORHAM, 66, Victoria-st, Westminster, London, S.W. **See Advt., p. 15**
Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C. London, and Branches. **See Advts., pp. 453, 484, 524, 547, 570, and 572**
ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-st-chbrs, Queen-st, London, E.C.; and Wolverhampton.
ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**
FERRANTI—Ferranti (S. Z. de) Limited, St. Benét-chmbrs, Fenchurch-st, and 27, Charterhouse-sq, London, E.C. **See Advt. on next page**
GENERAL ELECTRIC COMPANY, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham, and Manchester. **See Advt., p. 486**
GOOLDEN (W. T.) & CO, Woodfield Works, Harrow-rd, London, W.
JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C.; and Victoria Works, Charlton, Kent. **See Advt., p. 3**
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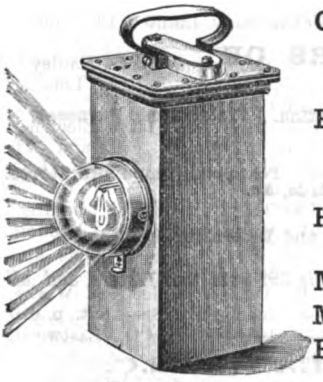

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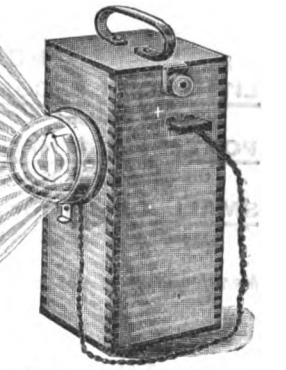

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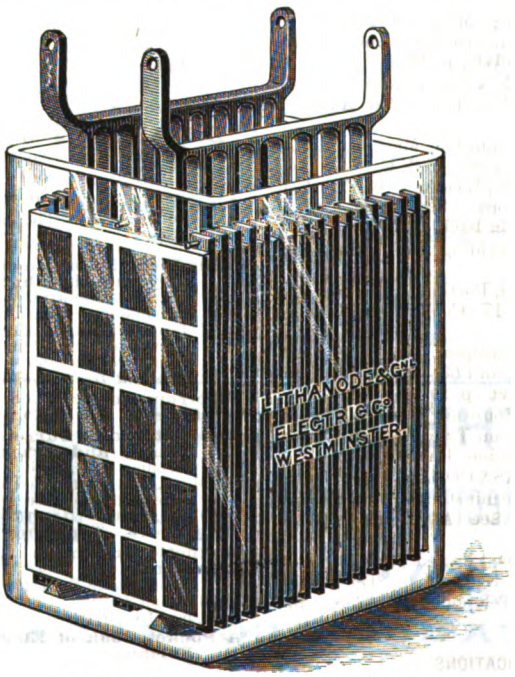

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SELIG, SONNENTHAL & CO, 85, Queen Victoria-st, and Lambeth-hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7**
Smith & Grace, Thrapston; and 35, Queen Victoria-st, London, E.C. (Screw Boss Pulley)
Watson, Laidlaw & Co, 98, Dundas-st, Glasgow
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**
YOUNGS, Ryland-street Works, Birmingham

PULLEY BLOCK MAKERS.

BAGSHAWE BROS. & CO, 4A, Upper Thames-st, London, E.C. **See Advt. on next page and p. 617**
Newbold (Walter) & Co, 1A, Laurence Pountney-hill, London, E.C.
Selig, Sonnenthal & Co, 85, Queen Victoria-st, and Lambeth-hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7**
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1.**
YOUNGS, Ryland-street Works, Birmingham

PUMPS, HAND AND STEAM, MAKERS OF.

BELLISS (G. E.) & CO, Limited, Ledsam-street Works, Birmingham; and 9 Victoria-st London, S.W. **See Advt., p. 558**
BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Ultrium London*)
Water and Acid Pumps.
EVERED & CO, Limited, 27-31, Drury-lane, W.C., 143, High-st, Shoreditch, E., and 50, Holborn-viaduct, E.C., London; and Surrey Works, Smethwick. **See Advt., p. 38**
NELL, FREDERIC, 16, Mark-lane, London, E.C.
Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.
Selig, Sonnenthal & Co, 85, Queen Victoria-st, and Lambeth-hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7**
Warner (Robert) & Co, 27, Jewin-crescent, London, E.C.; and Engineering Works, Walton-on-the-Naze, Essex
Waterspout Engineering Company, Sidney-street Works, Salford, Manchester
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**
YOUNGS, Ryland-street Works, Birmingham

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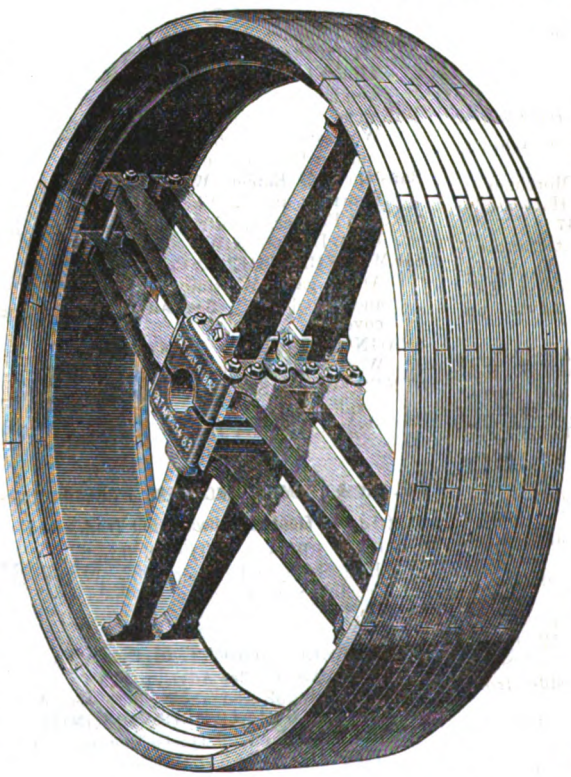

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Newbold (Walter) & Co, 1A, Laurence Pountney-hill, London, E.C.
Selig, Sonnenthal & Co, 85, Queen Victoria-st, and Lambeth-hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7**
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1.**
YOUNGS, Ryland-street Works, Birmingham

PUSHES, MAKERS OF.

BAGSHAWE BROS. & CO, 4A, Upper Thames-st, London, E.C. **See Advts. on preceding page and p. 617**
Baxendale & Co, Miller-st, Manchester; and Edinburgh
BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Wood (small and large), Porcelain and Ebonite.
BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.
BONNELLA (D. H.) & SON, 58, Mortimer-st, W., and 42 and 43, Kirby-st, Hatton-gdn, E.C., London. **See Advt., p. 647**
Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**
EVERED & CO, Limited, 27-31, Drury-lane, W.C., 143, High-st, Shoreditch, E., and 50, Holborn-viaduct, E.C., London; and Surrey Works, Smethwick. **See Advt., p. 38**
GOODWIN (H. G.) & SON, 42 and 43, Kirby-st, Hatton-gdn, London, E.C. **See Advt., p. 647**
HARRIS (A. & E.) & CO, 95, Camden-st, Birmingham
Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.
New York Hamburg India Rubber Company, 8, Coleman-st, London, E.C.
Schofield, B., Diggle, near Oldham, Lancs.
SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**
SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.
TAYLOR, TUNNICLIFF & CO, Eastwood, Hanley; and 47, Holborn-viaduct, London, E.C. **See Advt., p. 485**

PYROMETERS, MAKERS OF.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Prof. Braun's Electrical Pyrometers.
PAUL, ROBERT W., 44, Hatton-gdn, and Leather-lane, London, E.C. **See Advts., pp. 524 and 621**
SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt inside front cover**

RAIL BENDERS.

Baxendale & Co, Miller-st, Manchester; and Edinburgh
Newbold (Walter) & Co, 1A, Laurence Pountney-hill, London, E.C.
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**
YOUNGS, Ryland-street Works, Birmingham

RAILWAY SIGNAL MAKERS.

Automatic Electric Railway Signal Co, Ltd, 11, Rumford-pl, Liverpool (Patentees)
BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.
DUTTON & CO, Limited, Railway Signal Works, Worcester; and 70 and 71, Palace-chmbrs, Westminster, London, S.W.
ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st London, E.C.; and Wolverhampton
McKenzie & Holland, Vulcan Iron Works, Worcester; and 61, Sinclair-rd, West Kensington Park, London, W.
Ransomes & Rapier, Waterside Iron Works, Ipswich; and 32, Victoria-st, London, S.W.
Saxby & Farmer, Limited, Canterbury-rd, Kilburn, London, N.W.
SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**
SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.
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(*See also* **Electric Railways and Tramways.**)

ASKHAM BROS. & WILSON, Limited, Yorkshire Steel and Engineering Works, and Crucible Steel Foundry, Sheffield
BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.
BLACKWELL, ROBERT W., 39, Victoria-st, London, S.W. **See Advt., p. 525**
Brain, C. T. B., 32, Garmoyle-rd, Liverpool
BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, S.E., London
ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st, London, E.C.; and Wolverhampton
ELECTRICAL POWER STORAGE COMPANY, Limited, 4, Great Winchester-st, London, E.C. **See Advt. on back cover**
EPSTEIN ELECTRIC ACCUMULATOR COMPANY, Limited, 21A, Blythe-rd, West Kensington, W. (*Peroxide London*), and 213, Gresham House, Old Broad-st, E.C. (*Alchymist London*), London. **See Advt., p. 449**
MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. (*Mather Manchester; Bathmetal London*)

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Sellon, S. P. W. D'Alte, Electric Construction Company, Limited, Queen-st-chmbrs, Queen-st, London, E.C.

SIEMENS BROTHERS & CO. Limited, 12, Queen Anne's gate, Westminster, London, S.W.; and Woolwich. **See Advt. inside front cover**

Smith, M. Holroyd, 161, Trinity-rd, Upper Tooting, London, S.W.

Telegraph Manufacturing Company, Limited, Helsby, near Warrington

THAMES IRON WORKS AND SHIP-BUILDING COMPANY, Limited, Orchard Yard, Blackwall, London, E. **See Advt. inside end cover**

Thomson-Houston International Electric Company, 35, Parliament-st, Westminster, London, S.W.

RAILWAYS, ELECTRIC.

(*See also* **Electric Railways and Tramways.**)

BLACKWELL, ROBERT W., 39, Victoria-st, London, S.W. **See Advt., p. 525**

ELECTRIC CONSTRUCTION COMPANY, Limited, Queen-street-chmbrs, Queen-st, London, E.C.; and Wolverhampton

EPSTEIN ELECTRIC ACCUMULATOR COMPANY, Limited, 21A, Blythe-rd, West Kensington, W. (*Peroxide London*), and 213, Gresham House, Old Broad-st, E.C. (*Alchymist London*), London. **See Advt., p. 449**

MATHER & PLATT, Limited, Salford Iron Works, Manchester; and 16, Victoria-st, London, S.W. (*Mather Manchester; Bath-metal London*)

RAILWAYS, PRINCIPAL BRITISH, AND CHIEF OFFICIALS

(*see pp. 252 and 253*).

READING LAMPS, MAKERS OF.

BRITISH ELECTRIC LIGHT COMPANY, THE, Limited, 11, Delahay-st, Westminster, London, S.W. **See Advt., p. 49**

RECEIVERS, MAKERS OF.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
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RECORDING INSTRUMENTS, MAKERS OF.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*).
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Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

NALDER & HARRISON, Trafalgar House, Great Newport-st, Charing Cross-rd, London, W.C. **See Advt., p. 523**

PAUL, ROBERT W., 44, Hatton-gdn, and Leather-lane, London, E.C. **See Advts., pp. 524 and 621**

REFLECTOR AND SHADE MANUFACTURERS.

Baird, John, 71, Bishop-st, Port Dundas, Glasgow

Baxendale & Co, Miller-st, Manchester; and Edinburgh

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Enamelled Steel, Bright Metal, Opal and Silverescent Glass Reflectors

Brett (E.) & Co, 31, Foley-st, London, W. (Silk and Lace)

Burman, R. H., 10, Weaman-st, Birmingham

Burtlees, Tate & Co, Poland-st Glass Works, Oldham-rd, Manchester

Dernier (Louis) & Co, 78, Newman-st, London, W.

DORMAN & SMITH, Ordsal Station Electrical Works, Salford, Manchester; and 11, Grocers' Hall-court, Poultry, London, E.C. **See Advt., p. 11**

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts, pp. 453, 484, 524, 547, 570 and 572**

Entwisle & Stephens, 10, Gray's Inn-rd, London, W.C.

Falkirk Iron Company (R. W. Kennard & Co), 67, Upper Thames-st, London, E.C.; and Liverpool, Glasgow and Edinburgh. Works: Falkirk, N.B.

Goodyer, Frank Brunton, 155, New Bond-st, and 326, Oxford-st, London, W.

Haskell, E., 18, Baker-st, Portman-sq, London, W. (Paper and Silk)

Heine Bros. & Co, 74, Milton-st, London, E.C.

Imperial Enamel Company, Watery-lane, Birmingham

Jones Bros & Co, Ablow-st, Wolverhampton

Lamaille (G.) & Co, 40, Aldermanbury, London, E.C.

Mills, Walker & Co, Limited, Wordesley, Staffs; and 19, Charterhouse-st, London, E.C.

Northwood, J. & J., Glass Works, Wordesley, near Stourbridge

Permanent Enamel Company, Pelly-rd, Plaistow London, E.

Robinson (Wm.) & Co, Limited, Cleveland-rd, Wolverhampton

SCHÖLZIG, OSCAR, 9, New Broad-st, London, E.C.

VERITY (B.) & SONS, 31 and 32, King-st, Covent Garden, W.C., and 137, Regent-st, W., London; Plume Works, Aston, Birmingham; and 29, Princes-st, Manchester

Vickers (Percival) & Co, Limited, 64, Jersey-st, Manchester

Williams & Bach, 92, New Bond-st, and 3, Woodstock-st, Oxford-st, London, W.

REGULATORS, MAKERS OF.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Automatic Potential Regulators, Accumulator Battery Regulators, &c.

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, Lambeth, S.E., London

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DUTTON & CO, Limited, Railway Signal Works, Worcester; and 70 and 71, Palace-chmbrs, Westminster, London, S.W.
Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.

RESISTANCE COILS, MAKERS OF.

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria st, E.C., and 112, Belvedere-rd, Lambeth, S.E., London
CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**
CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**
DUTTON & CO, Limited, Railway Signal Works, Worcester; and 70 and 71, Palace-chmbrs, Westminster, London, S.W.
Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**
Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.
ELLIOTT BROS, 101, St Martin's-lane, London, W.C. **See Advt., p. 518**
GOOLDEN (W. T.) & CO, Woodfield Works, Harrow-rd, London, W.
MATHER & PLATT, Limited, Salford Iron Works, Manchester: and 16, Victoria-st, London, S.W. (*Mather Manchester; Bath-metal London*)
Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.
MUIRHEAD & CO, 2, Princes-st, Great George-st, London, S.W. **See Advt., p. 521**
NALDER BROS. & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 499**
NALDER & HARRISON, Trafalgar House, Great Newport-st, Charing Cross-rd, London, W.C. **See Advt., p. 523**
PAUL, ROBERT W., 44, Hatton-gdn, and Leather-lane, London, E.C. **See Advts., pp. 524 and 621**
Sherborne Electric Installation, Sherborne, Dorset
SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**

RESISTANCE COILS, WIRES AND STRIPS FOR, MAKERS OF.

Hadfield's Steel Foundry Company, Limited, Hecla Works, Sheffield; and 156 and 157, Leadenhall-st, London, E.C.

RESISTANCE FRAMES (ADJUSTABLE), MAKERS OF.

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BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, Lambeth, S.E., London
Edison & Swan United Electric Light Company Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**
LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, 64, Millbank-st, S.W., and 11, Abchurch-lane, E.C., London. **See Advt., p. 602**
NALDER & HARRISON, Trafalgar House, Great Newport-st, Charing Cross-rd, London, W.C. **See Advt., p. 523**
PAUL, ROBERT W., 44, Hatton-gdn, and Leather-lane, London, E.C. **See Advts., pp. 524 and 621**

RHEOSTATS, MAKERS OF.

BARTON, THOMAS, Electric Works, Blackburn (*Barton Blackburn, 265*)
BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Edison & Swan United Electric Light Company, Limited, 100, Victoria-st and 50, Parliament-st, S.W., and 110 Cannon-st, E.C. London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**
Electrical Accessories Company, Limited, 110, Charing Cross-rd, London, W.C.
LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, 64, Millbank-st, S.W., and 11, Abchurch-lane, E.C, London. **See Advt., p. 602**
MUIRHEAD & CO, 2, Princes-st, Great George-st, London, S.W. **See Advt., p. 521**
NALDER BROS. & CO., 16, Red Lion-st, Clerkenwell, London, S.E. **See Advt., p. 499**
PITKIN, JAMES, 56, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 491**
PAUL, ROBERT W., 44, Hatton-gdn, and Leather-lane, London, E.C. **See Advts., pp. 524 and 621.**
Variey and large Carbon Rheostats.
Sherborne Electric Installation, Sherborne, Dorset
WESTINGHOUSE ELECTRIC COMPANY, Limited, 32, Victoria-st, London, S.W. **See Advt., p. 487**

ROLLING MILLS AND ROLLED METAL MERCHANTS.

BEESLEY (W. T.) & CO, Limited, Attercliffe-rd and Effingham-st, Sheffield. **See Advt., p. 618**
London Zinc Mills, Limited, Wenlock-rd, London, N.

ROPE (MANILLA, HEMP, &c.,) MANUFACTURERS.

HAGGIE (R. HOOD) & SON, Queen-st, Newcastle-onTyne
WILLCOX (W. H.) & CO, 34 and 36, Southwark, st, and Castle-st, London, S.E. **See Advt. p. 1**

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SCHOOLS, COLLEGES, &c.

(*See also* **Colleges, Schools, &c.,** *and pp. 264-273*)

ELECTRICAL AND GENERAL ENGINEERING COLLEGE, Penywern House, 2 and 4, Penywern-rd, Earl's Court, London, S.W. **See Advt., p. 461**

SCIENTIFIC APPARATUS, MAKERS OF.

Apps, A., 433, West Strand, London, W.C.
Bateman (John) & Co, 205 and 206, High Holborn, London, W.C.
Bezant, W. A., 12, Bath-st, Leamington
Cambridge Scientific Instrument Company, St. Tibb's-row, Cambridge
Edmondson, Joseph, 36, Sunbridge-rd, Bradford
ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**
Morris Bros, Limited, Great Hampton-st, Birmingham
Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.
NALDER BROS. & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 499**
NALDER & HARRISON, Trafalgar House, Great Newport-st, Charing Cross-rd, London, W.C. **See Advt., p. 523**
Negretti & Zambra, Holborn-viaduct, London, E.C.
Newton (F.) & Co, 3, Fleet-st, London, E.C.
Oakley (W. H.) & Co, 202 and 203, Grange-rd, London, S.E.
Orme (J.) & Co, 65, Barbican, London, E.C.
PAUL, ROBERT W., 44, Hatton-gdn, and Leather lane, London, E.C. **See Advts., pp. 524 and 621**
PITKIN, JAMES, 56, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 491**
Sherborne Electric Installation, Sherborne, Dorset
SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon
SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.
Theobald (J.) & Co, 19, Farringdon-rd, E.C., and 20, Church-rd, Kensington, W., London
White, James, 16-20, Cambridge-st, Glasgow

SCIENTIFIC, OPTICAL AND CENERAL INSTRUMENT MAKERS.

Ambridge (H.) & Sons, 48, Myrtle-st, Hoxton, London, N.
Anderson, James, 10, Crawford-passage, Clerkenwell, London, E.C.
Aston & Mander, 25, Old Compton-st, London, W.
BARKER (FRANCIS) & SON, 12, Clerkenwell-rd, London, E.C. **See Advt., p. 462**
Bendon (G.) & Co, 36 and 37, Ely-pl, and 1, Charterhouse-st, London, E.C.
Browning, J., 73, Strand, London, W.C.
Callieu & Bartlett, 11A, Featherstone-bldgs, London, E.C.
Clarkson, Alex., 28, Bartlett's-bldgs, Holborn, London, W.C.
Committi (O.) & Son, 69, Mount-pleasant, Gray's Inn-rd, London, W.C.
Curtis Bros, 10, Suffolk-st, Dublin
Dallmeyer, J. H., Limited, 25, Newman-st, London, W.
Dollond & Co, 35, Ludgate-hill, and 62, Old Broad-st, London, E.C.
Doublet, T. & H., 11, Moorgate-st, London, E.C.
Eagland, Joseph, 152, Farringdon-rd, London, W.C.
Edwards, Matthew, 209, Sauchiehall-st, Glasgow
Eidmans (Joseph S.) & Co, 15, Bartlett's-bldgs, London, E.C.; and at Sheffield
ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**
Esdaile & Son, 28, Queen's-row, Walworth, London, S.E.
Hawkes, John, 2, Albany-st, Camberwell, London, S.E.
Heath & Co, Limited, Crayford, Kent; and 115-117, Cannon-st, London, E.C.
HICKS, JAMES J., 8, 9, 10, Hatton-gdn, London, E.C. **See Advt., p. 35**
Jackson (F.) & Co, 10, Halfmoon-st, Manchester
Joseph, Davis & Co, 5, Kennington Park-rd, London, S.E.
Lambert (E.) & Son, 60 and 62, Queen's-rd, Dalston, London, N.E.
Levi (S. J.) & Co, 71, Farringdon-rd, London E.C.
McCarthy, W. H., 9, Mount Pleasant, London, W.C.
McInnes (T. S.) & Co, Ltd, 86, York-st, and 341, Argyle-st, Glasgow
Moore, W. H., 10, Milner-sq, London, N.
NALDER BROS. & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 499**
Newman & Guardia, 92, Shaftesbury-av, London, W.C.
Oram (George) & Son, 19, Wilmington-sq, London, E.C.
Osman & Co, 132 and 134, Commercial-st, London, E.
Penso, Victor, 55, Hatton-gdn, and 8, 13, and 14, Hatton-yard, London, E.C.
Peover, William, 27, Leigh-st, Burton-cres, London, W.C.
PITKIN, J., 56, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 491**
Pizzali, C. F., 26, Charles-st, Hatton-garden, London, E.C.
Ronketti, J., 25, Northampton-rd, London, E.C.
Roskell & Co, Limited, 8 and 9, Martin's-lane, Cannon-st, London, E.C.
Ross & Co, 111, New Bond-st, London, W.
Schall, K., 55, Wigmore-st, London, W.
Scientific Alliance, 7 and 8, Dyer's-bldgs, Holborn, London, W.C.
Short & Mason, 40, Hatton-gdn, London, E.C.
Short, John, 2, Gladstone-terrace, Southwark, London, S.E.
Stone, Wm., 41, Gloucester-st, London, W.C.
Simmons, G. A., 90, Hatton-gdn, London, E.C.
VINTER, W., 3, Dyer's-bldgs, Holborn, London, E.C. (Divider and Engraver)

SCREW STOCK AND DIE TAP MAKERS.

AUTOMATIC STANDARD SCREW COMPANY, Halifax. **See Advts. on next page and p. 634**
Churchill (Charles) & Co, Limited, 21, Cross-st, Finsbury, London, E.C.; and 61, Albert st, Birmingham

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HATCH, GEORGE, Crown Wharf, 5, Upper Thames-st, London, E.C.
Newbold (Walter) & Co, 1A, Laurence Pountney-hill, London, E.C.
SELIG, SONNENTHAL & CO, 85, Queen Victoria-st, and Lambeth Hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7**
SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**
Wynn, Timmins & Co, Limited, Century Works, Commercial-st, Birmingham
YOUNGS, Ryland-street Works, Birmingham

SCREW THREADS, MAKERS OF.

AUTOMATIC STANDARD SCREW COMPANY, Halifax. **See Advts. below and p. 634**
Lehmann, Th., 38, Hampshire-st, Torriano-avenue, London, N.W. (B.A. Standard)
SOUTH OF ENGLAND ELECTRIC MANUFACTURING COMPANY, Pump Pail, Croydon, and Cromwell Iron Works, Croydon
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

SCREWS AND TERMINALS, MAKERS OF.

(*See also* **Terminals, Screws, &c.**)

Armstrong, Stevens & Son, Birmingham
ATKINS (CHAS.) & NISBET, 1, Water-lane, Great Tower-st, London, E.C. **See Advt., p. 634**
AUTOMATIC STANDARD SCREW COMPANY, Halifax. **See Advts., below and p. 634**
BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Butler Bros, 4, Station-bldgs, Haggerston, London, N.E.
Collier (Edward) & Sons, Stour Valley Works, Barker-st Parade, Birmingham
Daniell, S. A., Lion Works, Edward-st Parade, Birmingham
Davis & Timmins, Limited, 34A, York-rd, King's Cross, N., and 28, Hatton-gdn, E.C., London

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Stiffin & Co, 51, Roding-rd, Homerton, London, N.E.
Stokes (A.) & Co, Green-st, Deritend, Birmingham

SEALING-WAX MANUFACTURERS (*see* Insulating Materials).

SEARCH LIGHTS, MAKERS OF (*see* Projectors).

SECONDARY GENERATORS (*see* Transformers).

SECOND-HAND ELECTRICAL PLANT, BUYERS OF AND DEALERS IN.

Cartmell, J. Monkhouse, 35, West George-st, Glasgow
HUDDLESTON, PERCY, 21, Upham Park-rd, Chiswick, London, W.; and at Manchester
Sherborne Electric Installation, Sherborne, Dorset
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

SHADE MAKERS (*see* Reflector and Shade Makers).

SHAFTING MAKERS (*see also* Pulley and Shafting).

BAGSHAWE BROS. & CO, 4A, Upper Thames-st, London, E.C. **See Advts., pp. 606 and 617**
HATCH, GEORGE, Crown Wharf, 5, Upper Thames-st, London, E.C.
SELIG, SONNENTHAL & CO, 85, Queen Victoria-st, and Lambeth Hill, London, E.C. **See Advts., pp. 4, 5, 6 and 7**
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**
YOUNGS, Ryland-street Works, Birmingham

SHEET METAL WORKERS AND JAPANNERS.

BENHAM & FROUD, Limited, 40, Chandos-st, Strand, London, W.C.
EVERED & CO, Limited, 27-31, Drury-la, W.C., 143, High-st, Shoreditch, E., and 50, Holborn-viaduct, E.C., London; and Surrey Works, Smethwick. **See Advt., p. 38**
Ewart & Sons, 346, Euston-rd, London, N.W.
HARRIS (A. & E.) & CO, 95, Camden-st, Birmingham

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GRIFFITHS BROS. & CO, Macks-rd, Bermondsey, London, S.E. (*Aquol London, 4807*) **See Advt., p. 550**
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(*See also* **Cable Laying, &c., Ships, Builders of.**)

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EASTON & ANDERSON, Limited, 3, Whitehall-pl, London, S.W.; and Erith, Kent. **See Advt., p. 516**
Fairfield Shipbuilding and Engineering Company, Limited, Govan
Harland & Wolff, Belfast
NAPIER (R.) & SONS, Govan, Glasgow. **See Advt. on opposite page**
Palmer's Shipbuilding and Iron Company, Ltd, Jarrow; and King-st, Quayside, Newcastle
THAMES IRON WORKS AND SHIPBUILDING COMPANY, Limited, Orchard-yd, Blackwall, London, E. **See Advt. inside back cover.**
Thompson, James & George, Limited, Clyde Bank, near Glasgow.
Thompson (Robert) & Sons, Southwark-yard, and Bridge Dock-yard, Sunderland

SHIP FITTERS FOR ELECTRIC LIGHTING, &c.

ALLEN (W. H.) & Co., York-street Works, Lambeth, London, S.E. **See Advt., p. 37**
Baxendale & Co, Miller-st, Manchester; and Edinburgh.
BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.
BRITISH ELECTRIC LIGHT COMPANY, The, Limited, 11, Delahay-st, Westminster, London, S.W. **See Advt., p. 49**
BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, 49, Queen Victoria-st, E.C., and 112, Belvedere-rd, Lambeth, S.E., London
CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**
CLARKE, CHAPMAN & CO, Limited, Victoria Works, Gateshead-on-Tyne. **See Advt., p. 46**
CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**
DRAKE & GORHAM, 66, Victoria-st, London, S.W. **See Advt., p. 15**
Fuller & Tate, 20, Bucklersbury, London, E.C.
Hall (J. P.) & Co, Blackriding Ironworks, Werneth, Oldham
HOLMES (J. H.) & CO, Portland-rd, Newcastle-upon-Tyne; and 17, Coleman-st, London, E.C.
LITHANODE AND GENERAL ELECTRIC COMPANY, Limited, 64, Millbank-st, S.W., and 11, Abchurch-lane, E.C., London. **See Advt., p. 602**
Lund Bros. & Co, 123 and 125, Oxford-st, London, W.
MACCARTHY, C. C., Belfast Electrical Works, 23, Corporation-sq, and 16, William-st South, Belfast. **See Advt., p. 49**
Moody Bros., 66, Victoria-st, London, S.W.
PATERSON & COOPER, European Works, Pownall-rd, Dalston, N.E., and 3, Prince's-mansions, S.W., London; and 137, West Regent-st, Glasgow. **See Advt., p. 39**
PYKE, HARRIS & CO, Limited, 33 and 34, New Tothill-st, Westminster, London, S.W.
RETTIE, CHARLES, 18, Geraint-st, Liverpool
Russell & Co, 11, Queen Victoria-st, London, E.C.; and 6 St. Andrews-st, Cambridge
Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.
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IDE, T. & W., Glasshouse-fields, Ratcliff, London, E.; and at Birmingham. **See Advt., p. 570**
WALLET (DUNCAN) & CO, 114, Fenchurch-st E.C., and Mansel-st, E., London. **See Advt., p. 10**
Wild, Dagger & Co, 6B, The Temple, Dale-st, Liverpool
WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**
YOUNGS, Ryland-street Works, Birmingham

SHIPS' TELEGRAPHS, MAKERS OF.

Bassnett, Thomas, 10, Bath-st, Liverpool
BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.
Chadburn & Son, Telegraph Works, 11, Waterloo-rd, Liverpool; 69, Anderston Quay, Glasgow; and 105, Fenchurch-st, London, E.C.
ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt, p. 518**
France & Morgan, Whitefield Brass Works, Carmichael-st, Govan, Glasgow
Grinyer, George, 63, White Horse-st, London, E.
Hornsey, W., 17, Bernard-st, Southampton
Paterson & Cooper, European Works, Pownall-rd, Dalston, N.E., and 3, Prince's-mansions, Victoria-st, S.W., London. **See Advt., p. 39**
Robinson (A.) & Co, 32 Strand-st, Liverpool
Sewill, John, 61, Castle-st, and 14 and 16, Canning-pl, Liverpool
SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W.; and Woolwich. **See Advt. inside front cover**

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BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.
BRITISH ELECTRIC LIGHT COMPANY, THE, Limited, 11, Delahay-st, Westminster, London, S.W. **See Advt., p. 49**
CROMPTON & CO, Limited, Mansion House-bldgs, Queen Victoria-st, E.C., and 148, Brompton-rd, S.W., London. Works: London and Chelmsford. **See Advts., pp. 56 and 302, and inside back cover**
Fuller & Tate, 20, Bucklersbury, London, E.C.
Lund Bros. & Co, 123 and 125, Oxford-st, London, W.
MacCarthy, C. C., Belfast Electrical Works, 23, Corporation-sq, and 16, William-st South, Belfast. **See Advt., p. 49**
Moody Brothers 66, Victoria-st, London, S.W.
PATERSON & COOPER, European Works, Pownall-rd, Dalston, N.E., and 3, Prince's-mansions, Victoria-st, S.W. **See Advt., p. 39**
PYKE, HARRIS & Co, Limited, 33 and 34, New Tothill-st, Westminster, London, S.W.
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ASHTON, GREEN, MATHEWS & CO, 61, St. Mary-axe, London, E.C.; Temple-gate, Bristol; and Aberllefenny, North Wales (To H.M. Government)
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Nevill, Druce & Co, Llanelly; and 74, King William-st, London, E.C.
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(*For Officials, see* ALPHABETICAL SECTION, *&c.*)

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British Association for the Advancement of Science, Burlington House, London, W.
British Iron Trades' Association, 29, Great George-st, London, S.W.
Chartered Institute of Patent Agents, 19, Southampton-bldgs, London, W.C. (*For List of Fellows see p. 76*)
Chemical Society, Burlington House, Piccadilly, London, W.
Civil and Mechanical Engineers' Society, 12, Delahay-st, Westminster, London, S.W.
Federated Institution of Mining Engineers, Newcastle-upon-Tyne
Institute of Chemical Technology and Analytical Laboratory, Hackins Hey, Dale-st, Liverpool
Institute of Chemistry, 30, Bloomsbury-sq, London, W.C.
Institution of Civil Engineers, 25, Great George-st, London, S.W.
Institution of Civil Engineers of Ireland, 35, Dawson-st, Dublin
INSTITUTION OF ELECTRICAL ENGINEERS, 2, Victoria-mansions, Victoria-st, London, S.W. (*For List of Council and Officers, &c., see pp. 257 and 262*)
Institution of Engineers and Shipbuilders in Scotland, 207, Bath-st, Glasgow
Institution of Mechanical Engineers, 19, Victoria-st, London, S.W.
Institute of Scientific Research, 67, Broad-st, Birmingham
Iron and Steel Institute, 28, Victoria-st, London, S.W.
Junior Engineering Society, Westminster Palace Hotel, London, S.W.
Liverpool Physical Society, University College, Liverpool
London Association of Foremen Engineers and Draughtsmen, Cannon-st Hotel, Cannon-st, London, E.C.
London Chamber of Commerce, Botolph House, Eastcheap, London, E.C.
Machinery Users' Association, 8, Laurence Pountney-hill, Cannon-st, London, E.C.
North-East Coast Institution of Engineers and Shipbuilders, 4, St. Nicholas-bldgs West, Newcastle-on-Tyne
Northern Society of Electrical Engineers, 102, Portland-st, Manchester
Old Students' Association, Finsbury Technical College, Leonard-st, Finsbury, London, E.C.
Philosophical Society of Glasgow, 107, Bath-st, Glasgow
Physical Society of Glasgow University, Glasgow
Physical Society of London, Royal College of Science, Exhibition-rd, South Kensington, London, S.W.
Polytechnic Institution, 309 and 311, Regent-st, London, W.
Royal Astronomical Society, Burlington House, Piccadilly, London, W.
Royal Engineers' Institute, Chatham
Royal Institution of Great Britain, 21, Albemarle-st, London, W.
Royal Meteorological Society, 22, Great George-st, London, S.W.
Royal Microscopical Society, 20, Hanover-sq, London, W.
Royal Physical Society, 13, George-st Edinburgh
Royal Society, Burlington House, Piccadilly, London, W.
Société Internationale des Electriciens (Hon. Sec. and Treasurer British Section, R. Aylmer, M.I.C.E.), 47, Victoria-st, London, S.W. (*Leclanché London*)
Society of Arts, 18 and 19, John-st, Adelphi, London, W.C.
Society of Chemical Industry, Palace-chmbrs 9, Bridge-st, Westminster, London, S.W.
Society of Engineers, 17, Victoria-st, London, S.W.
Tramways Institute, 18, Eldon-st, and 19, Finsbury-circus, London, E.C.
Yorkshire College Engineering Society, Yorkshire College, Leeds

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BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
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DRAKE & GORHAM, 66, Victoria-st, London, S.W. **See Advt., p. 15**
ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**
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Haseler (Charles) & Son, 94, Bridge-st West, Birmingham.
HATCH, GEORGE, Crown Wharf, 5, Upper Thames-st, London, E.C.
King, Arthur, Pinxton, near Alfreton
PAUL, ROBERT W., 44, Hatton-gdn, and Leather-lane, London, E.C. **See Advts., pp. 524 and 621**
SELIG, SONNENTHAL & CO, 85, Queen Victoria-st, and Lambeth Hill, London, E.C. **Advts., pp. 4, 5, 6 and 7**

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WILLCOX (W. H.) & CO, 34 and 36, Southwark-st, and Castle-st, London, S.E. **See Advt., p. 1**

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Lansard & Co, 216, Goswell-rd, London, E.C.
Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

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FLEMING, BIRKBY & GOODALL, Limited, West Grove Mill, Halifax. **See Advts., pp. 466 and on next column**
MOSSES & MITCHELL, 68 to 71, Chiswell-st, London, E.C. **See Advts., pp. 578 and below**
RAMSDEN, CAMM & CO, Limited, Brighouse, Yorkshire; and 72, King William-st, London, E.C. **See Advt., p. 10**
Reynolds & Co, 57, New Compton-st, London, W.C.
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(*See also* **Gauge Makers.**)

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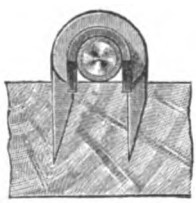

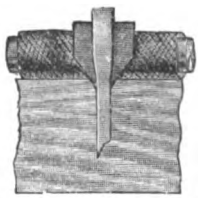

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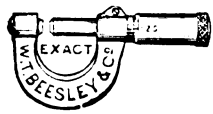

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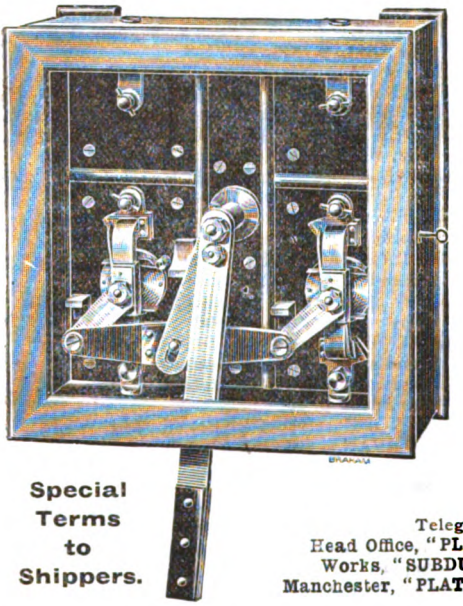

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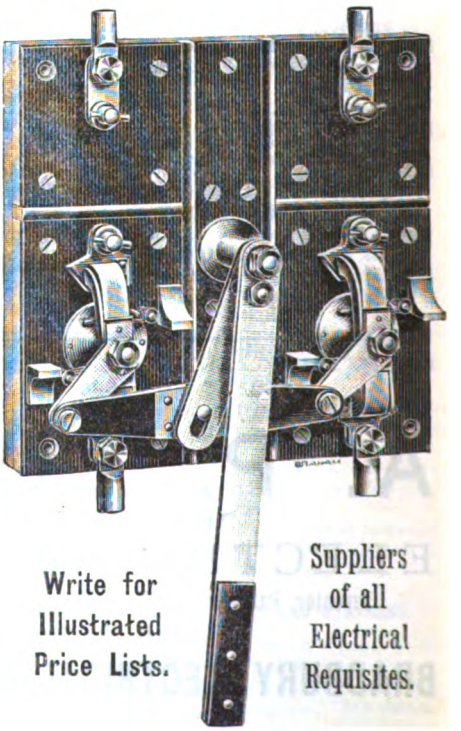

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Mather, Richard, Pond-st, Sheffield

Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

MUIRHEAD & CO, 2, Princes-st, Great George-st, London, S.W. **See Advt., p. 521**

NALDER BROS & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 493**

NUSSBAUM, G. A., C.E., General Agent for the Société Industrielle des Téléphones, 29, Ludgate-hill, London, E.C.

PHONOPORE COMPANY, Limited, Faraday House, Charing Cross-rd, London, W.C. **See Advt., p. 60**

Sax (Julius) & Co, Limited, 7, Ridgmount-st, Bedford-sq, W.C., and 366, Central Markets, West Smithfield, E.C., London

SIEMENS BROS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**

SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 33, Old Broad-st, E.C., and Wharf-rd, City-rd, N., London; and at Greenwich

Telegraph Improvement Company, Limited, 10, Austinfriars, London, E.C.

VERITY (B.) & SONS, 31 and 32, King-st, Covent Garden, W.C., and 137, Regent-st, W., London; Plume Works, Aston, Birmingham; and 29, Princes-st, Manchester

Walters (Philip) & Co, 249 & 251, Kensal-rd, and Conlan-st, London, W.

WOODHOUSE & RAWSON UNITED, Limited, 88, Queen Victoria-st, London, E.C. **See Advt., p. 55**

TELEGRAPH AND CABLE COMPANIES.

(For the Officials of these Companies see pp. 274 to 300; and for Tariffs to all parts of the World see pp. 207 to 210)

Telegraph and Cable Companies' Advertisements *will be found on pages* CXVIII. *to* CXXXI., *at end of Book.*

African Direct Telegraph Company, Limited, Winchester House, Old Broad-st, London, E.C.

African Trans-Continental Telegraph Company, Limited, 19, St. Swithin's-lane, London, E.C.

ANGLO-AMERICAN TELEGRAPH COMPANY, Limited, 26, Old Broad-st, London, E.C. *For List of Stations*, **see Advt., p. cxxvii.**

Brazilian Submarine Telegraph Company, Limited, Winchester House, Old Broad-st, London, E.C.

COMMERCIAL CABLE COMPANY (Mackay-Bennett Cables), Bishopsgate House, 55 and 56, Bishopsgate-st Within, London, E.C. **See Advt., p. cxxix.** (*See also* AMERICAN DIVISION)

Compagnie Française du Télégraphe de Paris à New York, 24, Royal Exchange, London, E.C. (*See also* CONTINENTAL DIVISION)

Cuba Submarine Telegraph Company, Limited, 58, Old Broad-st, London, E.C.

Direct Spanish Telegraph Company, Limited, 280, Winchester House, Old Broad-st, London, E.C.

DIRECT UNITED STATES CABLE COMPANY, Limited, Winchester House, Old Broad-st, London, E.C. *For List of Stations*, **see Advt., p. cxxviii.**

EASTERN TELEGRAPH COMPANY, Limited, Winchester House, Old Broad-st, London, E.C. *For List of Stations*, **see Advts., pp. cxviii. to cxxiii.**

EASTERN EXTENSION, AUSTRALASIA AND CHINA TELEGRAPH COMPANY, Limited, Winchester House, Old Broad-st, London, E.C. **See Advt., p. cxix.**

EASTERN AND SOUTH AFRICAN TELEGRAPH COMPANY, Limited, Winchester House, Old Broad-st, London, E.C. **See Advts., pp. cxxiv. and cxxv.**

EUROPE AND AZORES TELEGRAPH COMPANY, Limited, Winchester House, Old Broad-st, London, E.C.

Great Northern Telegraph Company, Limited, of Copenhagen, 3, St. Helens-place, Bishopsgate-st Within, London, E.C.

Halifax and Bermudas Cable Company, Limited, 33, Old Broad-st, London, E.C.

INDO-EUROPEAN TELEGRAPH COMPANY Limited, 18, Old Broad-st, London E.C. *For List of Stations*, **see Advt., p. cxxxi.**

London Platino-Brazilian Telegraph Company, Limited—*see* Western and Brazilian Telegraph Company, Limited

Pacific and European Telegraph Company, Limited, 212, Winchester-house, Old Broad-st, London, E.C.

Pacific Telegraph Company, Limited, 32, Victoria-st, London, S.W.

River Plate Telegraph Company, Limited, 188, St. Vincent-st, Glasgow

South American Cable Company, Limited, 106, Cannon-st, London, E.C.

Spanish National Submarine Telegraph Company, Limited, 106, Cannon-st, London, E.C.

WEST AFRICAN TELEGRAPH COMPANY, Limited, Winchester House, Old Broad-st, London, E.C. **See Advt., p. cxxvi.**

West Coast of America Telegraph Company, Limited, 120, Cannon-st, London, E.C.

West India and Panama Telegraph Company, Limited, Dashwood House, Old Broad-st, London, E.C.

Western and Brazilian Telegraph Company, Limited, 19, Great Winchester-st, London, E.C.

WESTERN UNION TELEGRAPH COMPANY, 252, Gresham House, Old Broad-st London, E.C. *For List of Receiving Offices*, **see Advt., p. cxxx.**

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TELEGRAPH AND CABLE COMPANIES' SUPERINTENDENTS.

(*For* Chief Officials at Colonial, Continental, and American Stations, *see* COLONIAL, CONTINENTAL, AND AMERICAN DIVISIONS, *and for* Chief Electricians, &c., of Companies' Cable Ships, *see page 227.*)

Anderson, J., Commercial Cable Company, Dundee

Ansell, W. T., F.R.G.S., Eastern Telegraph Company, Winchester House, Old Broad-st, London, E.C.

Ash, W. H., Eastern Telegraph Company, Limited, Porthcurnow, Treen, R.S.O., Cornwall

Bambridge, G. H., Commercial Cable Company, Bishopsgate House, 55 and 56, Bishopsgate-st, London, E.C. (General Superintendent in England).

Bolton, W., Eastern Telegraph Company, Limited, K13, Exchange-bldgs, Liverpool

Budden, R. W., Commercial Cable Company, Newcastle-on-Tyne

Bullock, T. A., Eastern Telegraph Company, Limited, 11, Old Broad-st, London, E.C. (Superintendent of London Stations)

Carson, J. H., Anglo-American Telegraph Company, Limited, Throgmorton-st, London, E.C. (Manager)

Cook, T., Commercial Cable Company, Edinburgh

Daggit, R. G., Commercial Cable Company, 15, Adelaide-st, Swansea

Edwards, J., Anglo-American Telegraph Company, Limited, Liverpool (Traffic Manager and Superintendent)

Furze, J., Commercial Cable Company, Liverpool

Graves, J., Anglo-American Telegraph Company, Limited, Valentia, co. Kerry

Kent, W. M., Commercial Cable Company, Manchester

Lamg, V. R., Great Northern Telegraph Company, Aberdeen

McGrath, E., Eastern Telegraph Company, Limited, 20, Brown-st, Manchester

Mygind, J., Great Northern Telegraph Company, Newcastle

Norman, J., Commercial Cable Company, Cardiff

Renwick, R. M., Eastern Telegraph Company, Limited, 5, Royal Bank-place, Glasgow

Taylor, F. A., Eastern Telegraph Company, Limited, Porthcurnow, Treen, R.S.O., Cornwall

Topping, F. W., Direct United States Cable Company, Limited, Ballinskelligs, co. Kerry

Tracey, H. J., Commercial Cable Company, Glasgow

Vennedt, C. F., Great Northern Telegraph Company, London

Ward, F., Commercial Cable Company, Weston-super-Mare

Weir, J., Commercial Cable Company, Leith

Wilmot, T. J., Commercial Cable Company, Waterville, co. Kerry

Williams, T. P., Commercial Cable Company, 8, Forster-sq, Bradford (Manager)

TELEGRAPH, &c., BUOY MAKERS.

Bellamy, John, Byng-st, Millwall, London, E.

JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C.; and Victoria Works Charlton, Kent. **See Advt., p. 3**

Jukes, Coulson, Stokes & Co, 13, Clement's-lane, E.C., and St. Leonard's Works, Bromley-by-Bow, E., London; and Carver-st, Sheffield

Telegraph Construction and Maintenance Company, 38, Old Broad-st, E.C., Morden and Enderby's Wharves, Greenwich, S.E., and 18, Wharf-rd, City-rd, N., London

THAMES IRON WORKS AND SHIPBUILDING COMPANY, Limited, Orchard-yd, Blackwall, London, E. **See Advt. inside end cover**

TELEGRAPH CABLES, MAKERS OF.

(*See also* **Electric Cable Makers.**)

Connolly Bros, Blackley, Manchester. **See Advt., p. 475**

FOWLER-WARING CABLES COMPANY, Limited, 4, Victoria-mansions, Victoria-st, London, S.W. **See Advts., pp. 362 and 475**

GLOVER (W. T.) & CO, Salford, Manchester; and Albany-bldgs, 39, Victoria-st, London, S.W. **See Advt., p. 40**

JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C., and Victoria Works, Charlton, Kent. **See Advt., p. 3**

NORTHERN ELECTRIC WIRE COMPANY, Sedburgh Mills, Halifax. (*Cables Halifax, 127*)

Registered Trade Mark.

SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 38, Old Broad-st, London, E.C.

Telegraph Manufacturing Company, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.

Gutta-Percha, Vulcanised Indiarubber, lead-covered. Highest references.

TELEGRAPH CONSTRUCTORS.

(*See also* **Telegraph Contractors.**)

BLACKBURN, R. S., 2, Hollins-cres, Hanging-royd-lane, Hebden Bridge, Yorks.

Harold & Co, 30 and 31, St. Swithin's-lane, London, E.C.

PHONOPORE COMPANY, Limited, Faraday House, Charing Cross-rd, London, W.C. **See Advt., p. 60**

SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**

SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 38, Old Broad-st, E.C., and Wharf-rd, City-rd, N., London; and Greenwich

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TELEGRAPH CONTRACTORS.

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

CALLENDER'S BITUMEN, TELEGRAPH & WATERPROOF COMPANY, Limited, 101, Leadenhall-st, London, E.C.; Oldham-place, Renshaw-st, Liverpool; Cannon-passage, Birmingham: and Erith, Kent

CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, Westminster, London, S.W. **See Advt., p. 59**

ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**

JOHNSON & PHILLIPS, 14, Union-court, Old Broad-street, London, E.C., and Victoria Works, Charlton, Kent. **See Advt., p. 3**

PHONOPORE COMPANY, Limited, Faraday House, Charing Cross-rd, London, W.C. **See Advt., p. 60**

RAMSDEN, CAMM & CO, Brighouse, Yorks. **See Advt., p. 10**

REID BROS, 12, Wharf-rd, City-rd, London, N. **See Advt., p. 14**

Russell & Co, 11, Queen Victoria-st, London, E.C.

SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**

SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 38, Old Broad-st, E.C., and Wharf-rd, City-rd, N., London; and Greenwich

Telegraph Manufacturing Company, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.

VERITY (B.) & SONS, 31 and 32, King-st, Covent Garden, W.C., and 137, Regent-st, W., London; Plume Works, Aston, Birmingham; and 29, Princes-st, Manchester

Walters (Philip) & Co, 249 and 251, Kensal-rd, and Conlan-st, London, W.

Whitley Partners, Limited, Railway Works, Hunslet-rd, Leeds

TELEGRAPH ENGINEERS.

See also TELEGRAPH COMPANIES' SUPERINTENDENTS.)

Adams, A. J. S., Postal Telegraphs, General Post Office, London, E.C.

Andrew, John R., London and North-Western Railway Company, Chester

Ansell, H. W., 26, Merton-rd, Wimbledon

Ashton, E., Postal Telegraphs, Glasgow

Ballard, W. H., Postal Telegraphs, Plymouth

Barker, Edward Raymond, India Rubber, Gutta Percha and Telegraph Works Co, Limited, Silvertown, London, E.

Barnett, M. Pat., M.I.C.E., Great North of Scotland Railway Company, Aberdeen

Baugh, Edward, Relay Office for West Irish Wires, Haverfordwest, Pem.

Bazeley, Thomas, Postal Telegraphs, Cardiff

Beckett, J. W., Postal Telegraphs, Lancaster

Bell, Andrew, 14, Argyle-cres, Portobello, Midlothian

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

Brittan, Thomas, 21, Hermes-st, Pentonville-rd, London, N.

Brown (F.) & Co, 44, Upper George-sq, Bryanston-st, London, W.

Burley, T., Midland Railway Company, Gloucester

Butler, W. H., Central Station, G.P.O., St. Martin's-le-Grand, London, E.C.

CALLENDER'S BITUMEN, TELEGRAPH AND WATERPROOF COMPANY, Limited, 101, Leadenhall-st, London, E.C.; Oldham-pl, Renshaw-st, Liverpool; Cannon-passage, Birmingham; and Erith, Kent

Campbell, Edward, Postal Telegraphs, Edinburgh

Carr, George M., Postal Telegraphs, Sunderland

Catley, Edward, Postal Telegraph Factory, Bovey-place, Holloway, London, N.

Chadburn & Son, Waterloo-rd, Liverpool; 69, Anderston-quay, Glasgow; and 105, Fenchurch-st, London, E.C.

Chambers, J. C., Superintendent Engineer, Postal Telegraphs, 17, Park-pl, Leeds

Chapman, J. B., 1st Class Technical Officer, General Post Office, London, E.C.

Chevalier, Fielding, Cable-ter, Waterville, Kerry, Ireland

CLARK (LATIMER), MUIRHEAD & CO, Limited, 23, Regency-st, London, S.W. **See Advt., p. 59**

Clement, A. F., North British Railway Company, 8, Princes-st, Edinburgh

Collins, Laurence, Post Office Telegraphs, Cork

Cooke, F. W., Retford

Cooper, M., General Post Office, London, E.C.

Crawford, Frank C., India Rubber, Gutta Percha and Telegraph Works Company, Silvertown, Essex

Crawford, William, 90, Abingdon-rd, London, S.W.

Culley, W. R., Post Office Cable Depôt, Dover

Curra, John W., Engineer-in-Chief's Office, General Post Office, London, E.C.

De Lattre, Alfred L., Engineer-in-Chief's Department, General Post Office, London, E.C.

Doherty, John, Postal Telegraphs, Manchester

Donovan, H. C., Fairfield, Mycenæ-rd, Westcombe Park, London, S.E.

Dunn, A. S., Superintendent of Telegraphs, Caledonian Railway, Glasgow

Eaton, H., Superintending Engineer, Postal Telegraphs (London District), Mount Pleasant, London, E.C.

Edmunds, Henry (W. T. Glover & Co), 39, Victoria-st, London, S.W.

Edwards, J. R., Postal Telegraphs, Liverpool

ELLIOTT BROS, 101, St. Martin's-lane, London, W.C. **See Advt., p. 518**

Ennis, P., General Post Office, London, E.C.

Estall, George, A.M.I.C.E., Metropolitan District Railway, Lillie Bridge Works, London, S.W.

Evans, F. E., Postal Telegraphs, Birmingham

Ferguson, Henry, Secretary's Office, G.P.O., St. Martin's-le-Grand, London, E.C.

Ffinch, B. T., Director-in-Chief, Indian Government Telegraph Department, India Office, Whitehall, London, S.W.

Fischer, H. C., Telegraph Controller, Central Telegraph Office, General Post Office, London, E.C.

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Fisher, H. O., Taff Vale Railway Company, Cardiff
Fleetwood, Charles T., Assistant Superintending Engineer, London and District Postal Telegraphs, Mount Pleasant, London, E.C.
Fleming, William, Superintendent Furness Railway Telegraphs, Barrow-in-Furness
Fletcher, J. W., Chief Telegraph Superintendent and Engineer, London and North-Western Railway Company, London-rd Station, Manchester
Forshaw, Alfred C., Direct United States Cable Company, 39, Mark-lane, London, E.C.
Foster, A. le Neve, 61, Cadogan-sq, London, S.W.
Fowler, Wm., Postal Telegraphs, Aberdeen
Francis, F. R., 1, Batoum-gardens, Kensington, London, W.
Fraser, James, Postal Telegraphs, Aberdeen
Fynn, Samuel, 670, Commercial-road, London, E.
Gavey, J., Principal Technical Officer, G.P.O., London, E.C.
Gibson, J., Postal Telegraphs, 38, York-pl, Edinburgh
Glegg, Alex., Phœnix Foundry, Mount Pleasant, Clerkenwell, London, E.C.
Goldstone, Charles, Superintendent London and South-Western Railway Telegraphs, Southampton
Goodenough, H. T., Great Western Railway, Paddington, London, W.
Graves, A., North-Eastern Railway Company, York
Gray, Robert Kaye (India Rubber, Gutta Percha and Telegraph Works Company), Silvertown, Essex; and 106, Cannon-st, London, E.C.
Greener, J. H., 15, Wallbrook, London, E.C.
Hampson, R. S., Manchester, Sheffield and Lincoln Railway, Godley Junction
Harper, R. R., Sash-ct, Wilson-st, Finsbury, London, E.C.
Hart, H. C., General Post Office, London, E.C.
Hartnell, H., 2nd Class Technical Officer, General Post Office, London, E.C.
Haynes, F. T. J., West of England and South Wales Division, Great Western Railway, Taunton
Heaviside, A. W., Postal Telegraphs, Newcastle-on-Tyne
Higgins, F., Exchange Telegraph Company, 17, Cornhill, London, E.C.
Hinton, W. G., Postal Telegraphs, Moorgate-street-bldgs, Moorgate-st, London, E.C.
Hoeltzer, C., Cambridge House, Old Charlton, Kent
Holdsworth, J. G., Post Office Telegraphs, Newcastle-on-Tyne
Hollins, F., Great Eastern Railway Company, Liverpool-st, London, E.C.
Holmes, J. R., 41, Ann-st, Glasgow
HOME TELEPHONE COMPANY, Limited, 85, Queen Victoria-st, London, E.C. **See Advt., p. 632**
Hookey, J., Assistant Engineer-in-Chief, General Post Office, London, E.C.
Hooper, J. P., Coventry Park, Streatham, London, S.W.
Hooper's Telegraph and India Rubber Works, 31, Lombard-st, E.C.; and Millwall, E., London
Houghton, J. E., London, Brighton and South Coast Railway, London Bridge, London, S.E.
Ireland, T., Great Northern Railway Co, Retford
Jackson, H. R., Lancashire and Yorkshire Railway Company, Horwich.
Jenkin, J., Postal Telegraphs, Cambridge
JOHNSON & PHILLIPS, 14, Union-ct, Old Broad-st, London, E.C., and Victoria Works, Charlton, Kent. **See Advt., p. 3**
Johnson, J. Thewlis, Bradford Ironworks, Manchester; and 8, Great Winchester-st, London, E.C.
Johnson (Richard) and Nephew, Manchester; Alderwasley, near Derby; and 8, Great Winchester-st, London, E.C.
Keith, George, C.E., Cuba Submarine Telegraph Company, Ltd, 58, Broad-st, London, E.C.
Kempe, H. R., A.M.I.C.E., General Post Office, London, E.C.
Langdon, William Edward, Midland Railway Company, Derby
Langdon-Davies, C., 45, Redcliffe-sq, South Kensington, London, S.W.
Langdon-Davies, W., 57, Comeragh-rd, West Kensington, London, W.
LATIMER CLARK, MUIRHEAD & CO, 23, Regency-st, Westminster, S.W. **See Advt., p. 59**
Lavender, J., M.S.A., Catherine-chmbrs, 11, Todd-st, Manchester
Leonard, William, South-Eastern Railway Company, Tunbridge
Leyshon, John W., Postal Telegraphs, Cardiff
Lucas, F. R., Engineer-in-Chief Telegraph Construction & Maintenance Co, Limited, Enderby's Wharf, Greenwich, London, S.E.
Lumsden, D., General Post Office, London, E.C.
McGregor, William, Polytechnic, Bournemouth
McLean, Donald, Post Office, Helensburgh, N.B.
Malan, E. de M., Hull and Barnsley Railway Company, Howden
Moon, W., Inniskillen, Ireland
Morgan, Charles Amiss, General Post Office, London, E.C.
Morgan, F., Central Telegraph Office, St. Martin's-le-Grand, London, E.C.
Morrison, Lieut. G., Postal Telegraphs, Leicester-sq. London, E.C.
Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.
MUIRHEAD & CO, 2, Princes-st, Great George-st, London, S.W. **See Advt., p. 521**
Muirhead, Dr. A., 5B, Cowley-st, Westminster, London, S.W. (Consulting)
Neale, J., North Staffordshire Railway Company, Stoke-on-Trent
Nicholl, Geo., Midland Railway, Derby
Noble, William, Postal Telegraphs, Aberdeen
Oakshott, A., Postal Telegraphs, Southampton
O'Brien, W. F., 98, Cannon-st, London, E.C.
Oppenheimer, J., 52, Brown-st, Manchester
Parmiter, Albert, A.I.E.E., Postal Telegraphs, Worcester
Paterson & Cooper, European Works, Pownall-rd, Dalston, N.E., and 68, Victoria-st, S.W., London. **See Advt., p. 39**
PHONOPORE COMPANY, Limited, Faraday House, Charing Cross-rd, London, W.C. **See Advt., p. 60**

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Pollard, Frederick, Submarine Depôt, Post Office Telegraphs, Dover
Pomeroy, H., Postal Telegraphs, Southern District, Cork
Price, Hugh, Postal Telegraphs, Cardiff
Pryce, H. J., North London Railway, Bow, London, E.
Redgrave, W. B., 4, Glenmohr-ter, Hyde-vale, Greenwich, London, S.E.
REID BROS, 12, Wharf-rd, City-rd, London, N. **See Advt., p. 14**
Reid, James, Glasgow and South-Western Railway Company, St. Enoch Station, Glasgow
Rudall, Francis, London, Chatham and Dover Railway Company, Victoria Station, Pimlico, London, S.W.
Saunders (J. B.) & Co, Cardiff
Saunders, H. A. C., Winchester House, Old Broad-st, London, E.C.
Sax (Julius) & Co, Limited, 7, Ridgmount-st, Bedford-sq, W.C., and 366, Central Markets, West Smithfield, E.C., London
Scott, Sergt.-Major J. T., Postal Telegraphs, 10, Leicester-sq, London, W.C.
Shepherd, F., Postal Telegraphs, Mount Pleasant, London, W.C.
SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**
Slater & Oakes, Traffic-st, Derby
SLINGO & BROOKER, 65, Chelsham-rd, Clapham, London, S.W.
Slingo, W., Central Telegraph Office, St. Martin's-le-Grand London, E.C.
Smith, Theophilus, Oversleigh, Wellington-rd, Old Charlton, Kent
Smith, William O., 101, St. Martin's-lane, London, W.C.
SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.
Spagnoletti, C. E., M.Inst.C.E., Phonopore Company, Limited, Faraday House, Charing Cross-rd, London, W.C.
Stallibrass, Edward, c/o W. Sharpey Seaton, 57½, Old Broad-st, London, E.C.
Stevenson, W., Caledonian Railway, Glasgow
Stewart, D., Postal Telegraphs, Glasgow
Stockdale, Lawson, London and North-Western Railway, Preston, Lancs.
Stuart, A. M., Capt. R.E., Brompton Barracks, Chatham
Sullivan, Herbert W., 29, Ladbroke-sq, London, W.
SYKES, W. R., Station-rd, High-st, Clapham, London, S.W.
The Sykes Lock and Block System of Signalling for Railways
Taylor, A. Lester, Prudential-bldgs, 36, Dale-st, Liverpool
Taylor, Herbert, 4, Great Winchester-st, London, E.C.
Taylor, J. E., Post Office Telegraph Instrument Factory, Bovay-pl, Holloway, London, N.
Telegraph Construction and Maintenance Co, Ltd, 38, Old Broad-st, E.C., Greenwich, S.E., and Wharf-rd, City-rd, N., London
Telegraph Manufacturing Company, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.
Thomson, E., 5, Featherstone-bldgs, Holborn, London, W.C.
Ticehurst, F. G., Langton House, Battle, Sussex
Tunbridge, W. T., Superintendent London and North-Western Railway Company, Stafford
Turner, John W., Postal Telegraph Factory, Bovay-pl, Holloway, London, N.
Varley, F. H., 82, Newington Green-rd, London, N.
Walby, J., Postal Telegraphs, Northern District, Belfast
Walker, E. O., C.I.E., M.I.E.E., Imperial Institute, London, S.W.
Walters (Philip) & Co, 249 and 251, Kensal-rd and Conlan-st, London, W.
Weatherall, T. E., Telegraph Construction and Maintenance Company, Greenwich, London, S.E.
Western Electric Company, 79, Coleman-st London, E.C. (*See also* AMERICAN DIVISION)
Wilkins, J. W., 15, Lilford-rd, Coldharbour Lane, Camberwell, London, S.E.
Woods, James W., Acting Superintending Engineer, Postal Telegraphs, Birmingham
Wyles, F., London and South-Western Railway, Waterloo Station, London, S.E.
Yeld, Edward, Postal Telegraphs, G.P.O., St. Martin's-le-Grand, London, E.C.

TELEGRAPH INSTRUMENT MAKERS.

(*See also* **Electrical Instrument Makers.**)

Aldridge, Frederick, 49, Northampton-st, London, E.C.
BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.
British Telegraph Manufactory, 210, Euston-rd, London, N.W.
Groves, W., 89, Bolsover-st, London, W.
MUIRHEAD & CO, 2, Princes-st, Great George-st, London, S.W. **See Advt., p. 521**
NALDER BROS. & CO, 16, Red Lion-st, Clerkenwell, London, E.C. **See Advt., p. 499**
PAUL, ROBERT W., 44, Hatton-gdn, and Leather-lane, London, E.C. **See Advts., pp. 524 and 641**
Sax (Julius) & Co, Limited, 7, Ridgmount-st, Bedford-sq, W.C., and 366, Central Markets, West Smithfield, E.C., London
SIEMENS BROS & CO, Ltd., 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**
SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.
Stocker & Co, 83 Upper Thames-st, London, E.C.; and at Leipzig, Hamburg, and Cologne
Telegraph Manufacturing Company, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.
Complete Railway Block and Speaking Apparatus, Morse Equipment, Post Office Apparatus, Line Stores Wires and Batteries.

Walters (Philip) & Co, 249 and 251, Kensal-rd, and Conlan-st, London, W.
White, James, 16-20, Cambridge-st, Glasgow
WOODHOUSE & RAWSON UNITED, Limited, 88, Queen Victoria-st, London, E.C. **See Advt., p. 55**

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TELEGRAPH INSTRUMENT INK MAKERS.

Field, James J., 25, Helmet-row, Old-st, London, E.C.

SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**

Slater & Palmer, 8, Wine Office-ct, E.C., and Marshgate-lane, E., London

Walters (Philip) & Co, 249 and 251, Kensal-rd, and Conlan-st, London, W.

TELEGRAPH LINES, CONSTRUCTORS OF.

BLACKBURN, R. S., 2, Hollins-cres, and Hanging-royd-lane, Hebden Bridge, Yorks

SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**

Spagnoletti & Crookes, Goldhawk Works, 39B, Goldhawk-rd, London, W.

Wild, Dagger & Co, 6B, The Temple, Dale-st, Liverpool.

TELEGRAPH POLES, MAKERS OF.

(*See* **Poles, Iron and Wood, Makers of.**)

TELEGRAPH TAPE PAPER MAKERS AND CUTTERS.

Colley's Patents, Limited, 147-150, Great Saffron Hill, London, E.C.

PAPER CUTTING, &c., COMPANY, 90, Goswell-rd, London, E.C. (*Toilet London*)
Contractors to H.M. Postal Telegraphs. Best English Paper Tapes for Morse, Hughes, Wheatstone, Recorder, and other Telegraph Instruments.

Vidalon Paper Mills, 165, Queen Victoria-st, London, E.C.

Waterlow & Sons, Limited, 25, 26, and 27, Great Winchester-st, 85 and 86, London-wall, and 52, New Broad-st, E.C., 49 and 50, Parliament-st, and 6, Cannon-row, S.W., London

TELEGRAPH TRUST COMPANIES.

GLOBE TELEGRAPH AND TRUST COMPANY, Limited, Winchester House, Old Broad-st, London, E.C.

SUBMARINE CABLES TRUST, Winchester House, Old Broad-st, London, E.C.

TELEGRAPH WIRE MANUFACTURERS.

(*See also* **Wire Manufacturers.**)

Burgess & Co, 18, Chapel-st, Liverpool

CALLENDER'S BITUMEN, TELEGRAPH AND WATERPROOF COMPANY, Limited, Leadenhall-st, London, E.C.; Oldham-place, Renshaw-st, Liverpool; Cannon-passage, Birmingham; and Erith, Kent

DENNIS (W. F.) & CO, 11, Billiter-st, London, E.C. (Agents for Felten and Guilleaume, of Mulheim-on-Rhine.) **See Advt., p. 9**

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572**

Espir, Fernand, 3, East India-avenue, London E.C. (Agent for Messrs. Lazare Weiller & Co. **See Advts.**)

FELTEN & GUILLEAUME, Mulheim-on-Rhine, Germany. (London Agents, Messrs. W. F. Dennis & Co, 11, Billiter-st, E.C.) **See Advt., p. 9**

FOWLER-WARING CABLES COMPANY, Limited, 4, Victoria-mansions, Victoria-st, London, S.W. **See Advts., pp. 302 and 475**

Fox (S.) & Co, Stockbridge Works, near Sheffield; and 18, St. Swithin's-lane, Cannon-st, London, E.C.

GLOVER (W. T.) & CO, Salford, Manchester; and Albany-bldgs, 39, Victoria-st, London, S.W. **See Advt., p. 40**

India Rubber, Gutta Percha and Telegraph Works Company, Limited, 106, Cannon-st, London, E.C., and Silvertown, Essex

King's Norton Metal Company, Limited, King's Norton, near Birmingham; and 16, Great George-st, London, S.W.

Künster & Co, 70, Gracechurch-st, London, E.C.

Lancashire High Conductivity Wire Company, St. Helens, Lancs. (London Agent, W. C. Carter, Mansion House-chmbrs, Queen Victoria-st, E.C.)

LONDON ELECTRIC WIRE COMPANY, Limited, Anchor Works, Playhouse-yd, Golden-lane, London, E.C. **See Advt., p. 12**

NORTHERN ELECTRIC WIRE COMPANY, Sedbury Mills Halifax. (*Cables Halifax, Ltd.*)

Registered Trade Mark.

Patterson, Walter, 32, King's-sq, Goswell-rd, London, E.C.

PHOSPHOR BRONZE COMPANY, Limited, 87, Sumner-st, Southwark, London, S.E. **See Advt., p. 438**

Power (F. A.) & Son, Midland Wire Mills, Saltley, Birmingham

RAMSDEN, CAMM & CO, Limited, Brighouse, Yorkshire; and 72, King William-st, London, E.C. **See Advt., p. 10**

REID BROS, 12, Wharf-rd, City-rd, London, N. **See Advt., p. 14**

Rickard, William, Ashbourne-road Mills, Derby

Rigby (J.) & Sons, Old and New Britannia Works, Wednesbury

Royston (J.), Son & Co, Shrogg's Mills, Halifax; and 44, Barbican, London, E.C.

Share (Geo. W.) & Co, 72, King William-st, E.C., and Suffolk-grove, Southwark, S.E., London

Shropshire Iron Co, Ltd, Hadley, near Wellington, Salop

Telegraph Manufacturing Company, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.
Gutta-Percha and Vulcanised Indiarubber Wires and Cables of best quality, highest references. Line Wires, Insulators, Batteries, Instruments.

Williams (John) & Co, Excelsior Iron and Steel Works, Wishaw

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TELEGRAPHIC NEWS ACENCIES.

Central News, Limited, 5, New Bridge-st, Ludgate-circus, and 5, Austin-friars, London, E.C.
Commercial Telegraph Bureaux, 11, Tokenhouse-yard, London, E.C.
Dalziel's Cable News Agency, Limited, 222-225, Strand, London, W.C.
Exchange Telegraph Company, Limited, 17 and 18, Cornhill, E.C., and 64, Haymarket, W., London
McLean's Telegraphic News Exchange, St. Stephen's-chbrs, Telegraph-st, London, E.C.
Press Association, 14, New Bridge-st, London, E.C.
Reuter's Telegram Company, Limited, 24, Old Jewry, London, E.C.

TELEPHONE APPARATUS MAKERS.

(*See also* **Electrical Apparatus Makers.**)

ALLSOP (F. C.) & CO, 165, Queen Victoria-st, London, E.C.
ANDERS' TELEPHONE COMPANY, Limited, Telephone-bldgs, 31, Queen Victoria-st, London, E.C. **See Advt., p. 630**
BARTON, THOMAS, Electric Works, Blackburn. (*Barton Blackburn, 265*)
Baxendale & Co, Miller-st, Manchester: and Edinburgh
BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Berliner's "Universal" Transmitter, and Telephone Supplies.
BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.
Collier-Marr Telephone and Electrical Manufacturing Company, Limited, Derby-st, Oxford-st, Manchester
CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 109, Farringdon-road, London, E.C. **See Advt., p. 629**
Croggon & Co, Limited, 16, Upper Thames-st, London, E.C.; 19, Tithebarn-st, Liverpool; and 7, John-st, Glasgow
Domestic Telephone Company, Ltd, 24, Fulham-rd, London, S.W.
Economic Telephone and Electric Supply Co, 58, North Corridor, Royal Exchange, Manchester
GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**
Gent & Co, Faraday Works, Leicester; 3, Maiden-lane, Queen-st, London, E.C.; 47, High-Bridge, Newcastle-on-Tyne; 27, Oswald-st, Glasgow; and at Cardiff and Belfast
Gomez, Henry, 45, Northampton-rd, Clerkenwell, London, E.C.
Hands (Alfred) & Co, 113, Leadenhall-st, London, E.C.
HOME TELEPHONE COMPANY, Limited, 85, Queen Victoria-st, London, E.C. **See Advt., p. 632**
Mattinson, J., 179, Latham-st, Liverpool
Mildé (Ch.) & Co (Representative in England, M. Kotyra), 60, Watling-st, London, E.C.
Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.
NATIONAL TELEPHONE COMPANY, Ltd., Oxford-ct, Cannon-st, London, E.C. **See Advt., p. 630**
NUSSBAUM, G. A., C.E., General Agent for the Société Industrielle des Téléphones, 29, Ludgate-hill, London, E.C.
SAX (JULIUS) & CO, Limited, 7, Ridgmount-st, Bedford-sq, W.C., and 366, Central Markets, West Smithfield, E.C., London
SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.
Stocker & Co, 83, Upper Thames-st, London, E.C.: and at Leipzig, Hamburg, and Cologne
Venezuela Telephone and Electrical Appliances Company, Limited, 37, Lombard-st, London, E.C.
WOODHOUSE & RAWSON UNITED, Limited, 38, Queen Victoria-st, London, E.C. **See Advt., p. 55**

TELEPHONE COMPANIES.

(*For Officials of these Companies see the Alphabetical Division and pp. 274 to 300*)

Anglo-Portuguese Telephone Company, Limited, 53, New Broad-st, London, E.C. (*See also* CONTINENTAL DIVISION)

CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, LTD.,

LONDON.

Telephones & Accessories

MANUFACTURERS SINCE 1881.

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ANDERS' TELEPHONE CO., Ltd.

Offices: TELEPHONE BUILDINGS, 31, Queen Victoria Street, London, E.C.,

And at PARIS and BERLIN.

Works: No. 1, CLERKENWELL ROAD, LONDON, E.C.

TELEGRAPHIC ADDRESS: "REMEASURE, LONDON."

MANUFACTURERS OF TELEPHONES FOR ALL PURPOSES. LONDON MADE.

All our Microphones are provided with a new material (Anders' Patent) which is highly sensitive, and preserves its effectiveness under varying current and climatic changes, and the Telephones, being of the most simple construction and substantially made, they are not liable to get out of order.

Our instruments are louder than any hitherto placed on the market, and they are designed for Commercial and Domestic purposes as well as for Railroads and Steamships.

Full particulars and information on application.

Chili Telephone Company, Limited, 42, Old Broad-st, London, E.C.

China and Japan Telephone Company, Limited, 14, Austin-friars, London, E.C.

CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 109, Farringdon-rd, London, E.C. **See Advt. p. 629**

Ecuador Telephone Company, 42, Old Broad-st, London, E.C.

HOME TELEPHONE COMPANY, Limited, 85, Queen Victoria-st, London, E.C. **See Advt., p. 632**

Monte Video Telephone Company, Limited, 321, Dashwood-house, New Broad-st, London, E.C.

NATIONAL TELEPHONE COMPANY, Limited (incorporating the United Telephone Company, Limited, the Lancashire and Cheshire Telephonic Exchange Company, Limited, the Northern District Telephone Company, Limited, the South of England Telephone Company, Limited, the telephone business of the Sheffield Electric Light and Telephone Company, Limited, the Western Counties and South Wales Telephone Company, Limited, and the Telephone Company of Ireland, Limited, Oxford-ct, Cannon-st, London, E.C. (*For List of Centres and other information see pp. 228 and 229.*) **See Advt. on p. 630**

New Telephone Company, Limited, Telephone Exchange, London-wall, London, E.C.; and 102, Portland-st, Manchester

Oriental Telephone and Electric Company, Limited, 14, Austin-friars, London, E.C.

Peru Telephone Company, Limited, 42, Old Broad-st, London, E.C.

Telephone Company of Austria, Limited—*in liquidation.* (*Exchanges taken over by Austrian Government as from Jan. 1, 1893.*)

Telephone Company of Egypt, Limited, 14, Austin-friars, London, E.C.

United River Plate Telephone Company, Limited, 9, New Broad st, London, E.C.

TELEPHONE ENGINEERS.

Aitken, W., National Telephone Company, Limited, Royal Exchange-bldgs, Glasgow

BARTON, THOMAS, Electric Works, Blackburn (*Barton Blackburn, 265*)

Baxendale & Co, Miller-st, Manchester; and Edinburgh

Bell, Horatio, National Telephone Co, Greenock

BENNETT, ALFRED ROSLING, 22, St. Alban's-rd, Harlesden, London, N.W. (Consulting)

Bennett, R. C., National Telephone Company's Exchange, Nottingham

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

THE NATIONAL TELEPHONE COMPANY, Limited.

Head Offices: Oxford Court, Cannon St., London, E.C.

(UNDER LICENSE FROM THE POSTMASTER-GENERAL.)

The National Telephone Company has erected and established—

540 EXCHANGES.	**53,784 EXCHANGE LINES.**
1,283 CALL OFFICES.	**10,257 PRIVATE LINES.**

218 Million Messages sent annually over the Company's Wires.

TELEPHONIC APPARATUS OF EVERY DESCRIPTION SUPPLIED ON HIRE, OR SOLD OUTRIGHT.

Estimates and full particulars can be obtained at the Company's Metropolitan Offices, 58 and 59, London Wall, E.C.

W. E. L. GAINE, General Manager.

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Calder, A., Metropolitan Manager, National Telephone Company, 53 and 59, London-wall, London, E.C.
Chambers, J. C., 4, Albion-pl, Leeds
Claxton, R. H., National Telephone Company, Limited, Manchester
Clay, C. B., National Telephone Company Limited, Oxford-ct, Cannon-st, London, E.C.
Collier, Arthur T., Netria, St. Albans, Herts; and Derby-st, Oxford-rd, Manchester
Collier-Marr Telephone and Electrical Manufacturing Company, Derby-st, Oxford-rd, Manchester
CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 109, Farringdon-rd, London, E.C. **See Advt. p. 629**
Cook, William W., National Telephone Co, Limited, 58 & 59, London Wall, London, E.C.
Corlett Electrical Engineering Company, Limited, Rowbottom-sq, Wigan; and Breightmet-st, Bolton
Cotterell, A. E., District Manager National Telephone Company, Limited, 40, Bennett's-hill, Birmingham
DAVIS (J.) & SON, All Saints Works, Derby; and 118, Newgate-st, London, E.C.
Edmunds, Henry (W. T. Glover & Co), 29, Victoria-st, London, S.W.
Fletcher, Thomas, National Telephone Company, Oxford-ct, Cannon-st, London, E.C.
Gaine, W. E. L., National Telephone Company, Limited, Oxford-ct, Cannon-st, London, E.C., and 100 St. George's-sq, S.W., London
Gent & Co, Faraday Works, Leicester; 3, Maiden-lane, Queen-st, London, E.C.; 47, High-bridge, Newcastle-on-Tyne; 27, Oswald-st, Glasgow; and at Cardiff and Belfast
Hindle, J. H., East-st, Bury, Lancs.
HOME TELEPHONE COMPANY, Limited, 85, Queen Victoria-st, London, E.C. **See Advt., p. 632**
Legg, John, 17 and 18, Nelson-st, Swansea
MacCARTHY, C. C., Belfast Electrical Works, 23, Corporation-sq, and 16, William-st South, Belfast. **See Advt., p. 49**
Macfee, John, jun., National Telephone Company, Limited, 8, Exchange-st, Sheffield
Mewburn, John, National Telephone Company, Limited, Hanley, Staffs.
Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.
MUIRHEAD & CO, 2, Princes-st, Great George-st, London, S.W. **See Advt., p. 521**
Muirhead, A. E., 19, Howard-st, and Cart Forge, Glasgow
Parsons, E. M., 10, Paragon-st, Hull
PATERSON & COOPER, European Works, Pownall-rd, N.E., and 3, Prince's-mansions, Victoria-st, S.W., London; and 137, West Regent-st, Glasgow. **See Advt., p. 39**
Patrick, J. & T., 46 & 55, Union-rd, Rotherhithe, London, S.E.
Phillips, C. J., National Telephone Company, Limited, 58, London-wall, London, E.C.
Preston, G. F. L., National Telephone Company, Commercial-st, Sheffield
PYKE, HARRIS & CO, Limited, 33 and 34, New Tothill-st, Westminster, London, S.W.
SIEMENS BROS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**
Sinclair, Dane, Engineer-in-Chief, National Telephone Company, Limited, Oxford-ct, Cannon-st, London, E.C.
SLINGO & BROOKER, 65, Chelsham-rd, London, S.W.
SMITH BROTHERS, Electrical Engineers, Northampton
Somerville, G. J., New Telephone Company, Limited, Telephone Exchange, 102, Portland-st, Manchester
SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.
Stansell & Son, East-st and Billet-st, Taunton
Swithinbank, J. W., National Telephone Company, Commercial-bldgs, Leeds
Thomas-Davies, G., Tylagwyn, Pontllanfraith, Glamorganshire
Ullett, J. W., M.I.E.E., National Telephone Co, 65A, Station st, Nottingham
Ward, Norman, National Telephone Co, Oxford-ct, Cannon-st, London, E.C.
Wild, Dagger & Co, 6B, The Temple, Dale-st, Liverpool

TELEPHONE EXCHANGES, EQUIPPERS OF.

Baxendale & Co, Miller-st, Manchester; and Edinburgh
BEREND (O.) & CO, 61, Fore-st, London, E.C.
(Yttrium London)
Berliner's Telephone Exchange Equipments.
CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 109, Farringdon-rd, London, E.C. **See Advt., p. 629**
HOME TELEPHONE COMPANY, Limited, 85, Queen Victoria-st, London, E.C. **See Advt., p. 632**
MacCARTHY, C. C., Belfast Electrical Works, 23, Corporation-sq, and 16, William-st South, Belfast. **See Advt., p. 49**
Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.
PATERSON & COOPER, European Works, Pownall-rd, Dalston, N.E., and 3, Princes-mansions, Victoria-st, S.W., London; and 137, West Regent-st, Glasgow. **See Advt., p. 39**
SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**
Telegraph Manufacturing Company, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.
Switchboards for single or metallic or combined circuits; Multiple Pattern; Test Boards, Distributing Boards; Cables, Wires, Batteries, Instruments, Insulators. Prompt delivery.

Western Electric Company, 79, Coleman-st, London, E.C.
Wild, Dagger & Co, 6B, The Temple, Dale-st, Liverpool

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TELEPHONE MOUTHPIECES FOR ALL KINDS OF TRANSMITTERS.

Audio Telephone Mouthpiece Company, 67, East Howard-st, Glasgow

CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 109, Farringdon-rd, London, E.C. **See Advt., p. 629**

HARBURG INDIA RUBBER C. COMPANY, 138, London-wall, London, E.C. **See Advts., pp. 471, 576 and 642**

New York Hamburg India Rubber Company, 8, Coleman-st, London, E.C.

SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.

Stentor Telephone Mouthpiece Company, 23 Regent-sq, London, W.C.

WINTER, F., 138, London-wall, London, E.C. **See Advts., pp. 471, 576 and 642**

TELEPHONE RECEIVER CASES, MAKERS OF.

HARBURG INDIA RUBBER C. COMPANY, 138, London-wall, London, E.C. **See Advts., pp. 471, 576, and 642**

WINTER, F., 138, London-wall, London, E.C. **See Advts., pp. 471, 576 and 642**

TELEPHONE TRANSMITTERS, MAKERS OF.

(*See also* **Telephone Apparatus Makers.**)

ANDERS' TELEPHONE COMPANY, Limited, Telephone-bldgs, 31, Queen Victoria-st, London, E.C. **See Advt., p. 630**

BEREND (O.) & CO, 61, Fore-st, London, E.C. (*Yttrium London*)
Berliner's "Universal" Transmitter; over 50,000 in use. Blake's and others. Only Award at Chicago, 1893.

CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 109, Farringdon-rd, London, E.C. **See Advt., p. 629**

GENERAL ELECTRIC COMPANY, Limited, 69 and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

SPAGNOLETTI & CROOKES, Goldhawk Works, 39B, Goldhawk-rd, London, W.

Western Electric Company, 79, Coleman-st, E.C.

TELEPHONE WIRE MANUFACTURERS.

(*See also* **Wire Manufacturers.**)

Connolly Bros., Blackley, Manchester. (*Connollys Blackley, 2367*) **See Advt., p. 475**

CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, Limited. 109, Farringdon-rd, London, E.C. **See Advt., p. 629**

DENNIS (W. F.) & CO, 11, Billiter-st, London E.C. (Agents for Felten and Guilleaume, of Mulheim-on-Rhine.) **See Advt., p. 9**

Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570 and 572.**

THE

HOME TELEPHONE COMPANY,

LIMITED.

Head Office { *85, Queen Victoria Street, London, E.C.*

TELEPHONE & TELEGRAPH ENGINEERS and CONTRACTORS.

The Company makes a specialty of Private Telephone external wires and internal installations, and has fitted up some of the largest Hotels, Offices, Warehouses, and Hospitals in the Metropolis and elsewhere.

Estimates Free.

The Company will sell outright or will lease its wires on an annual rental.

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Espir, Fernand, 3, East India-avenue, London, E.C. (Agent for Messrs. Lazare Weiller & Co. **See Advts.**)

FOWLER-WARING CABLES COMPANY, Limited, 4, Victoria-mansions, Victoria-st, London, S.W. **See Advts., pp. 302 and 475**

GENERAL ELECTRIC COMPANY, Limited, 69, and 71, Queen Victoria-st, London, E.C.; and at Glasgow, Birmingham and Manchester. **See Advt., p. 486**

GLOVER (W. T.) & CO, Salford, Manchester; and Albany-bldgs, 39, Victoria-st, London, S.W. **See Advt., p. 486**

Lancashire High Conductivity Wire Company, St. Helens, Lancs. (London Agent, W. C. Carter, Mansion House-chmbrs, Queen Victoria-st, E.C.)

LONDON ELECTRIC WIRE COMPANY, Limited, Anchor Works, Playhouse-yd, Golden-lane, London, E.C. **See Advt., p. 12**

NORTHERN ELECTRIC WIRE COMPANY, Sedburgh Mills, Halifax. (*Cables Halifax, 127*)

Registered Trade Mark.

PHOSPHOR BRONZE COMPANY, Limited, 87, Sumner-st, Southwark, London, S.E. **See Advt., p. 438**

RAMSDEN, CAMM & CO, Limited, Brighouse, Yorkshire; and 72, King William-st, London, E.C. **See Advt., p. 10**

REID BROS, 12, Wharf-rd, City-rd, London, N. **See Advt., p. 14**

Rickard, William, Ashbourne-road Mills, Derby

SIEMENS BROS. & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**

Telegraph Manufacturing Company, Limited, Helsby, near Warrington; and 11, Queen Victoria-st, London, E.C.

TELEPHONES, CONTRACTORS FOR THE SUPPLY AND ERECTION OF.

ANDREWS (J. D. F.) & CO, 15, Marsham-st, Westminster, London, S.W.

BARTON, THOMAS, Electric Works, Blackburn. (*Barton Blackburn, 265*)

Baxendale & Co, Miller-st, Manchester; and Edinburgh

Berry (W. D.) & Son, Faraday Works, Huddersfield

BINKO (H.) & CO, 34, Leadenhall-st, London, E.C.

BLACKBURN, R. S., 2, Hollins-cres, and Hangingroyd-lane, Hebden Bridge, Yorks.

BRITISH ELECTRIC LIGHT COMPANY, THE, Limited, 11, Delahay-st, Westminster, London, S.W. **See Advt., p 49**

Bryden (Wm.) & Son, 300, St. Vincent-st, Glasgow; and 55, George-st, Edinburgh

CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, Limited, 109, Farringdon-rd, London, E.C. **See Advt., p. 629**

CORLETT ELECTRICAL ENGINEERING COMPANY, Limited, Rowbottom-sq, Wigan; and Breightmet-st, Bolton

Cox-Walkers, North-Eastern Electric Works, Darlington; and 9 and 13, West Register st, Edinburgh

Croggon & Co, Limited, 16, Upper Thames-st, London, E.C.; 19, Tithebarn-st, Liverpool; and 7, John-st, Glasgow

Crossley Telephone Company, Limited, Albany-bldgs, Market-st, Bradford

DAVIS (J.) & SON, All Saints Works, Derby; and 118, Newgate-st, London, E.C.

Edison-Gower-Bell Telephone Company of Europe, Limited, 53, New Broad-st, London, E.C.

Ericsson Bell Telephone Company, 29, Waterloo-st, Glasgow

GENT & CO, Faraday Works, Leicester; 3, Maiden-lane, Queen-st, London, E.C.; 47 High Bridge, Newcastle-on-Tyne; 27, Oswald-st Glasgow; and at Cardiff and Belfast

Grant, J. M., Milton, Kingussie, N.B.

HARRIS, A. J. S., 85, Hazlehurst-rd, Manningham, Bradford

HOME TELEPHONE COMPANY, Limited, 85, Queen Victoria-st London, E.C. **See Advt., p. 632**

Huddleston, Percy, 21, Upham Park-rd, Chiswick, London, W.; and at Manchester

KING, MENDHAM & CO, Western Electrical Works, Narrow Wine and Fairfax-sts, Bristol; and 12, Fenchurch-st, London, E.C.

LECLANCHÉ & CO, (Sole Agent, R. Aylmer) 47, Victoria-st, London, S.W. (*Leclanché, London*) **See Advt., p 17**

Long, Thomas (late Liddiard and Wordley, Limited), 6 and 7, Bank-bldgs, Hastings

Lund Bros & Co, 123 and 125, Oxford-st, London, W.

MacCARTHY, C. C., Belfast Electrical Works, 23, Corporation-sq, and 16, William-st South, Belfast. **See Advt. p. 49**

Martin, W. W., Worcester Cross, Kidderminster

MATTHEWS & CO, Oxendon-st, Leicester

Mudford's Arrow Electrical Works, Jackson-rd, Holloway, London, N.

NUSSBAUM, G. A. General Agent for the Société Industrielle des Téléphones), 29, Ludgate-hill, London, E.C.

PATERSON & COOPER, European Works, Pownall-rd, Dalston, N.E., and 3, Princes-mansions, Victoria-st, S.W., London; and 137, West Regent-st, Glasgow. **See Advt., p. 39**

PYKE, HARRIS & CO, Limited, 33 and 34, New Tothill-st, Westminster, London, S.W.

Sax (Julius) & Co, Limited, 17, Ridgmount-st, Bedford-sq, W.C., and 366, Central Markets, West Smithfield, E.C., London

Scott (Ernest) & Mountain, Limited, Close Works, Newcastle-on-Tyne; and 5, Crown-ct, Cheapside, London, E.C.

Sherborne Electric Installation, Sherborne, Dorset

SIEMENS BROTHERS & CO, Limited, 12, Queen Anne's-gate, Westminster, London, S.W., and Woolwich. **See Advt. inside front cover**

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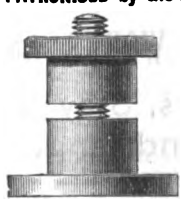

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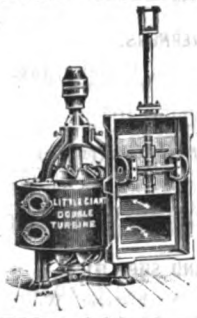

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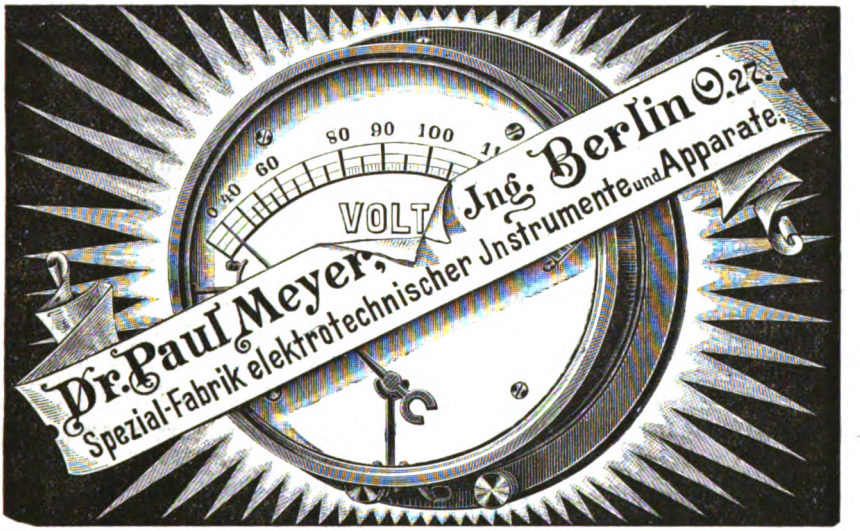

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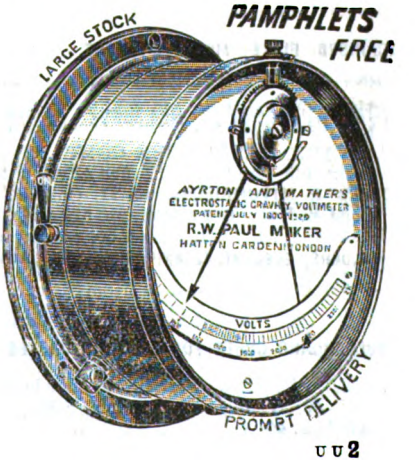

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Edison & Swan United Electric Light Company, Limited, 100, Victoria-st, and 50, Parliament-st, S.W., and 110, Cannon-st, E.C., London; and Branches. **See Advts., pp. 453, 484, 524, 547, 570, and 572**

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Harrison, G., 182, Drury-lane, London, W.C.

Hawkins Bros & Co, Enterprise Works, Bowling Green-lane, Farringdon-rd, London, E.C.

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COLONIAL GOVERNMENT ELECTRICAL DEPARTMENTS.

One of the principal drawbacks experienced in the endeavour to introduce new inventions, &c., to the notice of the heads of Government departments is the difficulty of selecting from the lists usually given the proper persons to be approached. With the object of rendering assistance, we have introduced the following authentic information for the benefit of patentees and manufacturers of instruments, apparatus, and plant who may desire to introduce electrical goods.

We are greatly indebted to the gentlemen who have so readily given us their assistance in procuring the particulars given.

BRITISH GUIANA.

POST AND TELEGRAPH DEPARTMENT.

Postmaster-General: F. W. Collins.
Consulting Electrician: W. H. Preece.
Chief Electrician: Samuel Vyle.
Assistant Electrician: Gilbert C. Vyle.

CANADA.

DEPARTMENT OF PUBLIC WORKS.

(The Government Telegraph Service is in this Department.)

Acting Superintendent: D. H. Keeley, Ottawa.

District Superintendents:—Hartley Gisborne, Qu'Appelle (North West Territory); Herbert Pope, South-West Point (Island of Anticosti); D. C. Dawson, St. John, N.B., Cape Breton (Nova Scotia); A. Le Bourdais, Grindstone Island (Magdalen Islands), E. Tètu, Pentecost, Q. (North Shore River and Gulf of St. Lawrence); J. Wilson, Vancouver (British Columbia); C. C. Seeley Grand Manan, N.B. (Bay of Fundy), Edwin Pope, Quebec (Quebec District).

CAPE COLONY.

POST AND TELEGRAPH DEPARTMENT.

Postmaster-General: S. R. French.
Superintendent of Telegraphs: B. Duff.

JAMAICA.

TELEGRAPH SERVICE.

Postmaster: Geo. W. Pearce.
Superintendent of Telegraphs: H. C. Wilson.
Consulting Electrician: W. H. Preece (London).
Director of Public Works: Hon. V. G. Bell.

NATAL.

POST AND TELEGRAPH DEPARTMENT.

Postmaster-General and General Manager of Telegraphs: J. Chadwick, J.P.
Engineering Inspector: T. T. Hardaker.

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NEW SOUTH WALES.

POST AND TELEGRAPH DEPARTMENT.

Postmaster-General: Hon. J. Kidd.
Secretary of Telegraph Service: P. B. Walker.
Chief Electrician: J. Nelson. Assistant: A. A. Dircks.

NEW ZEALAND.

POSTAL AND RAILWAY TELEGRAPHS AND TELEPHONE SERVICES.

Head Superintendent: C. Lemon, Ph.D., M.I.E.E.
Electrician: W. C. Smythe, A.I.E.E.

QUEENSLAND.

POST AND TELEGRAPH DEPARTMENT.

Postmaster-General: W. A. Wilson.
Under-Secretary and Superintendent of Telegraphs: John McDonnell.
Chief Manager (Telegraph Branch): R. D. Bourne.
Acting Mechanician: S. H. Smith.

SOUTH AUSTRALIA.

TELEGRAPH AND TELEPHONE SERVICE.

Head Superintendent: Charles Todd, C.M.G., M.A., F.R.S.
Deputy Superintendent: E. Squire.
Chief Electrician and Fitter: C. Unbehaun.

RAILWAY SERVICE.

Chief Electrician: Thos. J. Dewhirst.

TASMANIA.

TELEGRAPH AND TELEPHONE SERVICE.

Superintendent of Telegraphs and Telephones and Chief Electrician:
Capt. Robert Henry.
Manager of Telegraphs: Frank P. Bowden (Hobart).
Managers of Telephones: Frank P. Bowden (Hobart); Frank Allison (Launceston).
P. T. Rutt (Zeehan).
Inspector of Lines: M. Faber.
Electrical Mechanician: Thomas Self (Hobart).

GOVERNMENT RAILWAY TELEGRAPHS.

Superintendent: John J. McDonald.

VICTORIA.

POST OFFICE AND TELEGRAPH DEPARTMENT.

Postmaster-General: Hon. Agar Wynne.
Deputy Postmaster-General and General Superintendent of Telegraphs:
James Smibert.
Chief Electrician, Telegraph Engineer, and Manager Telephone Exchange
Melbourne: George Smibert.
Chief Inspector: G. S. Caldwell.

WESTERN AUSTRALIA.

TELEGRAPH AND TELEPHONE SERVICE.

Superintendent: William J. Hancock, M.I.E.E., A.M.I.C.E.
Inspector of Telegraphs: F. A. Bailey, A.I.E.E.

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INDIAN GOVERNMENT TELEGRAPH DEPARTMENT.

Director-General.—W. R. BROOKE, C.I.E.
Deputy Director-General.—J. H. LANE.
Director (Traffic Branch).—C. H. REYNOLDS.
Director (Construction Branch).—S. P. W. V. LUKE, C.I.E.

GENERAL ESTABLISHMENT.

Superintendents.

CLASS IV.

Bignell, W. K. D'O., Punjab.
Hill, T. C.
Melhuish, W. F., Calcutta.
Pitman, C. E., C.I.E., Check Office.

CLASS V.—1st GRADE.

Allen, J. J. (Electrician).
Bevan, J. F., Bombay.
Burke, J., Rajputana.
Charles, G. G., Sind and Baluchistan.
Hullah, A., Personal Assistant to the Director-General.
Kirk, H. A., Workshops.
Landon, C. P., Oude and Rohilkhand.
Larkins, A. B., Store Department.
Maclean, F. G., Calcutta.
O'Kelly, H. M.

CLASS V.—2nd GRADE.

Berrington, T. D., Malabar.
Brind, M. J.
Dempster, F. E., Burma.
Duffin, C., Dacca.
Gompertz, R. L. D., Arakan.
Hare, W. H. M., East Coast.
Hutchinson, S. H. C., Bombay Office.
Jones, W. C. N., Nagpur.
Leach, E. A., Indore.
Kinsman, F., Upper Burma.
Towers, G. L., Bellary.
Wheatley, G.

INDO-EUROPEAN TELEGRAPH DEPARTMENT.

LONDON OFFICE.

Director-in-Chief.—B. T. FFINCH.
Clerks.—C. E. J. Twisaday, C. W. Parratt, H. J. Andrews.

CONSTANTINOPLE OFFICE.

Agent.—T. J. Maltass.

PERSIAN GULF AND PERSIAN SECTIONS.

Director (Persian Gulf).—J. POSSMANN.
Director (Persian).—Lieut.-Col. H. L. WELLS, R.E., Teheran.
Assistant Director (Persian).—Major H. F. Chesney, R.E., Teheran.
Engineer and Electrician.—G. W. Sealy, Karachi.

Superintendents.

Allen, C. E., Karachi.
Fahie, J. J., Shiraz.
Harrison, H. B., Traffic Office.
Johnstone, T. Y.

Assistant Superintendents.

Barber, G., Persian Gulf.
Fargues, J., Teheran.
Graves, E., Ispahan.
Hawkins, J. P., Jask.
Navarra, W. S., Persia.
New, R. H., Bushire.
Smith, L. E. R., Store Department.
McMullen, B.
Medical Superintendent.—Dr. T. F. Odling. C.M.G., Teheran.
Assistant Medical Superintendent.—Dr. D. Scully, Shiraz.

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"THE ELECTRICIAN"

ELECTRICAL TRADES' DIRECTORY.

COLONIAL DIVISION.

ALPHABETICAL SECTION.

NOTES.—*Telegraphic and Cable Addresses and Telephone Numbers are shown in italics. In order to render* "THE ELECTRICIAN" ELECTRICAL TRADES' DIRECTORY AND HANDBOOK *as complete and serviceable as possible, the Editors will be glad to receive during 1894 Changes of Address, Names and Addresses not included in the present Edition, newly-registered Telegraphic and Cable Addresses and Telephone Numbers.* No charge is made for inserting these particulars.

An asterisk (*) *prefixed to a name indicates that a* BIOGRAPHICAL SKETCH *appears at the end of the book.*

Advertisers *in* THE DIRECTORY *will find* **prominent reference** *made to their Advertisements and to the pages in which they occur.*

— A —

Abell, Huot & Co, Electricians, St. Casimir, Que., Canada

Ahearn Electric Heating and Manufacturing Company, Manufacturers of Electric Heating Apparatus, Ottawa, Ont., Canada

Ahearn & Soper, Telegraph and Electric Light Engineers, 46, Sparks-st, Ottawa, Canada

Ahearn, T., Manager and Electrician, Chaudiere Electric Light and Power Company, Ottawa, Ontario, Canada

Alcock (A. U.) Electric Light and Motive Power Company, Limited, Electric Light and Power Engineers and Contractors, 171, Queen-st, Melbourne, Victoria. (A. U. Alcock, Managing Director and Electrician)

Alexander (H. A.) & Co, Manufacturers of Electrical Supplies, 19, Macquarie-pl, Sydney, N.S.W.

Allen, J. J., Telegraph Engineer, Indian Government Telegraphs, Calcutta. (Local Hon. Secretary of the Institution of Electrical Engineers)

Alleyn, H. M., Electrical Engineer, St. Clair, Talawekele, Ceylon

Allport, James Russell, Electrical Engineer, c/o G.P.O., Sydney, N.S.W.

Anderson, A., Electrician, Kimberley-chmbrs, and P.O. Box 164, Cape Town. (*Watchful Cape Town*)

Anderson (A. T.) & Co, Electrical Engineers, Manufacturers of Electric Motors, Dynamos, &c, 75, Adelaide-st. E., Toronto, Canada

Anderson, R., Electrical Engineer, 128½ Sparks-st, Ottawa, Ont., Canada

Anderson, T. E., Superintendent Eastern and South African Telegraph Company, Mauritius

Andrews, M. S., Director of Telegraphs, Accra, Gold Coast, West Coast of Africa

ANGLO-AMERICAN TELEGRAPH COMPANY, Limited, corner St. François Xavier-st, and St. Sacrament-st, Montreal, Canada. (*See also* BRITISH DIVISION) **See Advt., p. cxxvii.**

Anglo-Canadian Electric Storage and Supply Company, Manufacturers of Secondary Batteries, Ottawa, Canada

Arnot, A. J., M.I.E.E., A.M.I.C.E., Electrical Engineer to the City of Melbourne, and Instructor in Electrical Engineering at the W.M. College, Town Hall, Melbourne, Victoria

Arrow, James Thomas, A.M.I.C.E., Engineer-in-Chief's Department, Government Offices, Adelaide, South Australia

Ashby, W. F., Consulting Electrical Engineer, Durban, Natal

Ashcroft, Edgar A., Electrical Engineer, Flinders-lane, Melbourne, Victoria

Auldjo & Osborne, Consulting Mechanical and Electrical Engineers, 275, George-st, Sydney, N.S.W.

Austen Bros., Electrical Engineers, 239, Hollis-st, Halifax, Nova Scotia

Australasian Electric Company, Electrical Engineers and Contractors, 61, Queen-st, Melbourne, Victoria

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Australasian Electric Tramways Company, Limited. Office: 9, Queen-st, Melbourne, Victoria. (*Farad Melbourne, 1138*)

Austral Otis Engineering Company, Limited, Engineers and Machinery Merchants, Moray-st, South Melbourne, Victoria; Sydney, N.S.W.; and Brisbane, Queensland. (Agents for Messrs. Ganz & Co). (*Lyndentree Melbourne, 331*)

— B —

Badger, F. H., Electrician and Superintendent, City Fire Alarm Telegraphs, Montreal

Baer (W. T.) & Co, Electrical Apparatus Makers, 155, Queen-st. W. Toronto, Ont.

Bailey, A. J., Electrician to the Natal Harbour Board, Post Office, Point Durban, Natal

Bainton, J. R., Electrician, P.O. Box 1005, and 10, Clarence-st, Sydney, N.S.W.

Balbi, J. Louis, Electrician, 18, Strada Mezzodi, Malta

Ballarat School of Mines, Industries, and Science (in the University of Melbourne), Ballarat, Victoria. J. A. Dawson, A.I.E.E., Lecturer on Electrical Engineering

Ball Electric Light Company, Limited, of Canada, Electrical Engineers, 70-76, Pearl-st, Toronto, Ontario

Barton & White, Electrical Engineers and Contractors, off Creek-st and Edison-lane, Brisbane, Queensland (*403*)

Baxendale, A. S., Superintendent of Posts and Telegraphs, Selangor, Straits Settlements

Bayly, Brackenbury, Electrician, Surveyor and District Engineer, Cape Town

Baynes (R. B.) & Co., Agents for Callender's Bitumen, Telegraph and Waterproof Company, Limited, 7, Gresham-st, Sydney, N.S.W.

Beak & Tonks, Electrical Engineers, Kent's-bldgs, Adelaide, Brisbane, Queensland

Beall, S. W., Electrician, Somerset-pl, Little Bourke-st, Melbourne, Victoria

Beckett (F. G.) Engine Company, High Speed Steam Engine Makers, Hamilton, Ont.

Becks, G. A., A.M.I.C.E., Electrical and Mechanical Engineer, 37, Aliwal-st, Durban, Natal, South Africa. (*Becks Durban*)

Bengal Telephone Company, Limited, 7, Council House-st, Calcutta. (*Oakenpin Calcutta*)

Bennett & Wright, Electrical Engineers and Contractors, Toronto, Ont.

Bergemann, H. C., Electrical Engineer, Irrawaddy Flotilla Company, Dalla Dockyard, Rangoon, Burmah

Bernard, R. W., Agent, Eastern Extension Telegraph Company, Adelaide, South Australia

Betts, Lester B., Electrician, India Rubber, Gutta Percha, and Telegraph Works Company, Ltd, 12, Government-pl, Calcutta

Bevan, G. F., Electrical Engineer, Brush Electrical Engineering Company, Limited, 56, Margaret-st, Sydney, N.S.W.

Black, James Gow, M.A., D.Sc., Electrician, Professor of Chemistry at the Otago University, Dunedin, New Zealand

Black, G., Telegraph Engineer and Consulting Electrician, Great North-Western Telegraph Company, Hamilton, Ont.

Bloomfield Bros. Electrical Engineers, 214, Queen-st, Melbourne, Victoria

Boettger, G. A., Electrical Engineer, 11, Shortmarket-st, Cape Town.

Bold, Edward H., Assoc.M.I.C.E., Consulting Electrical Engineer and Inspector of Telegraphs, Napier, N.Z.

Bombay Telephone Company, Elphinstone-circle, Bombay; and at Karachi, India

F. Raper .. .. .. Man. & Elec.
H. Blackwell .. .. Secretary

Bombay University, Mayo-rd, Bombay (T. Cooke, M.A., and H. I. R. Hargrave, M.A., Professors of Engineering)

Booth, D. F., Electrician, and Secretary Western Australian Mechanical and Electrical Institute, Beaufort-st, Perth, Western Australia

Booth, J., Electrical Engineer, 31, Queen-st, Melbourne, Victoria

Bourne, Robert O., General Inspector, Post and Telegraph Department, Bowen, Queensland. (Local Hon. Secretary of the Institution of Electrical Engineers)

Bowden, F. P., Manager Government Telegraphs, Hobart, Tasmania (*70*)

Bowler, P., City Electrician, New Westminster, British Columbia

Bowman, Fred. A., M.A., B.E., Electrician and Superintendent, New Glasgow Electric Company, New Glasgow, Nova Scotia (*68*)

Bradford, John R., Telegraph Engineer, Telegraph Office, Brisbane

Brady & Todd, Electrical Engineers, 255½, Sussex-st, Sydney, N.S.W.

Brain, O. W., Electrical Engineer to the Crompton Electric Supply Company of Australia, Limited, 193, Clarence-st, Sydney, N.S.W.

Brearley, J. H. D., B.Sc., Electrical Engineer, 41, Darghan-st, Glebe, Sydney, N.S.W.

Breithaupt, E. Carl, Consulting Electrical Engineer, Berlin, Ont., Canada

Brenner, W. H., Electrical Engineer, Montreal Street Railway Company, Montreal, Que., Canada

Brice (A. W.) & Co, Manufacturers of Dynamos, Motors, &c., 20, John-st. N., Hamilton, Ontario, Canada

Briscoe, Drysdale & Co, Importers of Electrical Apparatus, 397, George-st, Sydney, New South Wales.

British Guiana Electric Lighting and Power Company, Limited, Electric Light and Power Contractors, Water-st, South Cumingsburg, Georgetown, British Guiana

Brooke, W. R., C.I.E., Director-General of Indian Government Telegraphs, Calcutta

BROWNE, R. JAMIESON, Electrical Engineer to the B.I.S.N. Company, Limited, Howrah Dock, Howrah, Calcutta

Browning, Walter W., Superintendent, Eastern Extension Telegraph Company, Nelson, New Zealand

Brownley Electric Manufacturing Company, Manufacturing Electricians, St. John's, New Brunswick

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Brush Electrical Engineering Company, Limited, Electrical Engineers and Contractors, 61, Queen-st, Melbourne, Victoria; and Sydney, N.S.W.; and Adelaide, S. Australia. (Oswald Haes and E. Martyn, Joint Managers.) (*See also* BRITISH DIVISION.)

Buckland, R. G. S., Superintendent, Eastern Extension, Australasia, and China Telegraph Company, Port Darwin, South Australia

Bullimore, M., Electric Light Engineer, Peel-st, Adelaide, South Australia

Burne, Oldbury, Telegraph Engineer, Indian Government Telegraphs, Umballa, India

Burns, John A., Mechanical and Electrical Engineer, 686, Craig-st, Montreal

Burran, Lewis, Electrical Engineer, Montmorency Electric Power Company, Quebec

Butcher, S., Telegraph Engineer, Indo-European Telegraph Department, Jask, India

Butterfield & Swire, Electricians and Electrical Engineers, Hong Kong

— C —

Caine, G. W., Superintendent, Eastern and South African Telegraph Company, Limited, Seychelles

Calcutta University, Calcutta. (Col. J. M. M'Neile, R.E., Professor of Engineering)

Callendar, H. L., Electrician, Prof. of Physics, McGill University, Montreal, Canada

Callender, Jas. O., Electrical Engineer, c/o R. B. Baynes & Co, 7, Gresham-st, Sydney, N.S.W.

Callender, Romaine, Electrician, Brantford Electrical Laboratory, Brantford, Ont., Canada

Campbell, Walter D., Telegraph Engineer, Government Telegraph Department, Ballarat, Victoria

Canada Electric Company, Limited, Manufacturing Electrical Engineers, Amherst, Nova Scotia. (D. M. Bliss, Electrician and Superintendent)

Canadian Electrical Association, 106-108 Confederation Life-bldg, Toronto, Ont.
J. J. Wright ... ... President
C. H. Mortimer, ... Secretary-Treasurer

Canadian Electrical Construction, Manufacturing and Supply Company, Manufacturing Electrical Engineers, Montreal, Canada

Canadian Electrical News and Steam Engineering Journal (monthly), 106-108 Confederation Life-Bldg, Toronto; and Temple-Bldg, Montreal, Canada. (Price $1 per annum.) (*2362*)

Canadian Engineer (Monthly), 62, Church-st, Toronto, Ont., Canada (Ann. sub., $1)

Canadian General Electric Company, Electrical Engineers and Contractors, 65 to 71, Front-st West, Toronto, Ont.; and at Montreal, Halifax, N.S., &c. Factory: Peterborough, Ontario

Canadian Institute, Toronto, Canada. (R. Ramsay Wright, M.A., B.Sc., Prof. of Biology, University of Toronto, President; A. MacDougall, M.I.C.E., Secretary)

Canadian Magazine of Science and Industrial Arts and Patent Office Record (monthly), 5-9, Bleury-st, Montreal, Quebec

Canadian Pacific Railway Company's Telegraphs. Head Offices: Montreal

Carey, Walter C., Electrician and Assistant Superintendent, Eastern Telegraph Company, Gibraltar

Carlisle, H., Superintendent, Eastern and South African Telegraph Company, Durban, Natal, S. Africa

Carroll Bros, Dealers in Electrical Supplies, 795, Craig-st, Montreal, Quebec, Canada

Carroll, John, Secretary and Treasurer, Phillips (Eugene F.) Electrical Works, St. Gabriel Locks, Montreal, Canada

Carus-Wilson, Prof. C. A., M.A., Electrician, McGill University, Montreal, Canada. (Local Hon. Secretary of the Institution of Electrical Engineers)

Cassidy, Thomas, Superintendent Eastern and South African Telegraph Company, Cape Town

Cashel, Barter & Co, Electricians, 528, Collins st, Melbourne, Victoria

Castle (J) & Sons, Makers of Electric Light Fittings, 51, King-st, Newtown, Sydney, N.S.W.

Ceffala, A. G., Superintendent, African Direct Telegraph Company, Sierra Leone, West Africa

Chadwick, J., J.P., Postmaster-General and General Manager of Government Telegraphs, Natal, South Africa

Chanteloupe, E., Electrician, 587, Craig-st, Montreal, Quebec, Canada

Charles, G. G., Superintendent, India Government Telegraphs, Calcutta

Chase, L. H., C.E., Electrical Engineer, St. John's Parsonage, Carlton, Melbourne, Victoria

Chevallier, C., Superintendent, Eastern Telegraph Company, Aden

Childs, A. E., B.Sc., Electrician, P.O. Box 1957, Montreal, Canada

Choquette, l'Abbé C. P., M.A., Professor of Physics, St. Hyacinthe, Canada

Christy, F. C., Consulting Engineer, Box 14, Exchange, Melbourne, Victoria

Chubb (H.) & Co, Dealers in Electrical Supplies, St. John, New Brunswick, Canada

Civil Engineering College, Seebpore, Howrah, Bengal. (S. F. Downing, M.A., A.M.I.C.E., Principal; Barada Prasnd Ghose, M.A., Lecturer in Physical Science.)

Clark (D. W.) & Son, Electric Light Engineers and Contractors, Carleton, St. John, New Brunswick.

Clarke, Geo. A., Electrician, 46, McKenzie-st, Balmain, Sydney, N.S.W.

Clarke, W. J., Electrician, Toronto, Ont., Canada

Clayton, Alfred, Electrician, Town Hall, Richmond, Melbourne, Victoria

Clayton-Joel (W.) & Co, Manufacturing Electrical Engineer, 620 and 493, Collins-st, Melbourne, Victoria

Clements, G. F., Electrician, c/o The Engineer for Existing Railways, Bridge-st, Sydney, N.S.W.

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Cogswell, A. R., Electrician and Superintendent, Halifax Illuminating and Motor Company, Limited, 34, Bishop-st, Halifax, N.S.

Cole, F. R., Electrical Engineer, 1,792, Notre Dame-st, Montreal, Quebec

College of Science, Poona, India (T. Cooke, M.A., LL.D., Principal)

Colley, Benjamin W., Superintendent, Commercial Cable Company, Hazel Hill, Nova Scotia

Compagnie Electrique, Manufacturing Electrical Engineers, St. Jean Baptiste, Montreal, Quebec

Cone and Knight, Dynamo Manufacturers, Fergus, Ontario, Canada

Congdon, A. W., Electrician and Agent for the General Electric Company (of America), Montreal, Canada

Connell Bros., Engineers and Electricians, Woodstock, New Brunswick

Connor & Green, Electricians, 5, Eastern Arcade, Melbourne, Victoria

Connor, F., Electrical Engineer, 196, Heidelberg st, Melbourne, Victoria

Conrad, Son & Co, Agents to the Thomson-Houston International Electric Company, Georgetown, British Guiana. (*Son Demerara*)

Consolidated Electric Company, Limited, Electrical Engineers, St. John, New Brunswick.

Coode, J. M., Telegraph Engineer, Indian Government Telegraphs, Nagpur

Cook & Son, Electrical Engineers and Contractors, St. Catharine's, Ontario

COOKE, JOHN HERBERT, Mechanical and Consulting Engineer and Licensed Patent Agent, King William-st, Adelaide, South Australia

Corbitt, M. W., Electrician, Messrs. T. W. Ness & Co, 749, Craig-st, Montreal

Cormac, Chas. Richard, Chief Inspector of Government Telegraphs, Kuala Lumpor, Selangor, Straits Settlements

Cortlandt Electrical Manufacturing Company, Manufacturing Electrical Engineers, Toronto, Ont.

Cowl, T. H., Chief Manager and Inspector of Telegraphs, Bowen, North Queensland

Craig-Russell Electric Company, Limited, Manufacturers of the Russell Arc Lamp, 180, St. James-st, Montreal, Canada

Crompton Electric Supply Company of Australia, Limited, Electric Light and Power Contractors, 193, Clarence-st, Sydney, New South Wales; Melbourne, Victoria, and Adelaide, South Australia. (K. H. Buchanan, Manager) (*See also* BRITISH DIVISION)

Crookes, Henry, A.R.S.U., Electrician, Post Office, Mafeking, British Bechuanaland, South Africa

Crosher, W., Dealer in Electrical Supplies, Electrical Depôt, Queen-st, Auckland, New Zealand

Cross, W. E, Electrical Engineer, P.O. Box 1280, Sydney, N.S.W.

Crow, John, Electrician, 147, Collins-street, Melbourne, Victoria. (*1210*)

Crump, W. C., Electrician, 44, Castlereagh-st, Sydney, N.S.W.

Cutmore, H., Electrical Engineer, 213, Little Collins-st, Melbourne, Victoria

D

Dalhousie College and University, Halifax, Nova Scotia

Civil Engineering { M. Murphy, D.Sc., C.E. / R. McColl, C.E.

Dando, H. K., Electrical Engineer, Lyttleton Harbour Board, Lyttleton, New Zealand

D'Araujo, P., Telegraph Engineer, Thaepeng, Perak, Straits Settlements

Darby, R., Superintendent, Eastern Extension Telegraph Co, Georgetown, Tasmania

Davidson, Alexander, Electrician, Anglo-American Telegraph Company's Cable Ship "Minia," Halifax, Nova Scotia

Davis, W. E., Electrical Engineer, Toronto Street Railway Company, Toronto

Dawson, J. A., A.I.E.E., Electrical Engineer, Lecturer on Telegraphy and Electrical Engineering at The School of Mines, Ballarat, Victoria (In the University of Melbourne)

Dell, J. J., Electrician, Cameron-st, Launceston, Tasmania

Denham, J., Electrician, Cape Government Railways, Salt River, near Cape Town, South Africa

Devitt, Thomas, Electrician, Eastern Telegraph Company, Malta

Dewhirst, Thos. Y., Chief Electrician, South Australian Government Railway Service, Glanville, S. Australia

Dey, Sil & Co, Electricians, Scientific Instrument Makers and Manufacturers' Agents, &c., 20, Lall Bazar-st, Calcutta, India

Dickenson, P. A., Electrical Engineer, 47, Colborne-st, Brantford, Ont., Canada

Dickenson, S. S., Superintendent, Commercial Cable Company, Canso, Nova Scotia

Dickenson, W., Telegraph Engineer, Anglo-American Telegraph Company, Heart's Content, Newfoundland

Dion, Alfred A., Electrician and Superintendent, Chaudiere Electric Light and Power Company, Limited, Ottawa, Ont., Canada

Dircks, A. A., Telegraph Engineer, Electric Telegraph Department, G.P.O., Sydney, N.S.W.

Dodd, Maynard, Chief Electrician, Anglo-American Telegraph Company's Cable Ship "Minia," Halifax, Nova Scotia

Dodge Wood Split Pulley Company, Makers of Special Pulleys for Electrical Purposes, 83, King-st West, Toronto, Ont.

Dominion Electrical Manufacturing Company, Manufacturing Electrical Engineers, 66, Adelaide-st, Toronto, Canada

Dominion Electric Company, Electrical Engineers, Montreal, Quebec, Canada

Dominion Telegraph Company, 18 and 20, Toronto-st, Toronto, Canada. (Frederic Roper, Secretary)

Dominion Wire Manufacturing Company, Manufacturers of Wire for Electrical Purposes, Montreal. Works: Lachine, Canada

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Dornbusch, E. G., A.M.I.E.E., &c., Electrician (Stuart & Dornbusch), 9, Farrell's-chmbrs, 72, King-st, Sydney, New South Wales

Douglas, S., Electrical Engineer, Kay Electric Works, Hamilton, Ontario

Dowson, Harold, Electrician, Department of Working Railways, Perth, Western Australia

Doyle, James D., Telegraph Engineer, Victorian Railways, Melbourne, Victoria

Draper (Thos. T.) & Co, Electrical, Mechanical and Consulting Engineers (Proprietors of the Union Electric Lighting Company, Limited), 144, Elizabeth-st, Melbourne, Victoria. (*Undeniable Melbourne*)

Drummond (W.) & Co, Electrical Instrument Makers, 29-31, Collins-st, W., Melbourne, Victoria

Duff, B., Superintendent of Telegraphs, Cape Town

Duff, C. F., Telegraph Engineer, Postal Telegraph Department, St. Anne's Bay, Jamaica

Dunbar, Wm., Inspector of Government Telegraphs, Cape Town, South Africa

Dunn & Poole, Electrical and General Engineers, 135, Swanston-st, Melbourne, Victoria

Dwight, H. P., Superintendent, Great North-Western Telegraph Co, Toronto, Canada

Dwight, Lyman, Dealer in Electrical Supplies, Winnipeg, Manitoba, Canada

Dymond, Edmund R., A.M.I.C.E., Electrician, The King's School, Parramatta, N.S.W.

— E —

Earle, Edward, Telegraph Engineer, Anglo-American Telegraph Company, Heart's Content, Newfoundland

Edkins, Albert E., Engineer and Electrician, 22, Agnes-st, Toronto, Canada

Edlin and Stevenson, Electrical Engineers, 92, Adderley-st, Cape Town, South Africa. P. O. Box 139 (*Electrical Cape Town*)

Edwards (J. E.) & Co, Electricians, 138, Little Collins-st, Melbourne, Victoria

Edwards, J. P., Assistant Surveyor, Postal Telegraphs, King William's Town, South Africa

Electric and Accumulator Company, Makers of Accumulators and Electrical Apparatus, 45, Queen-st East, Toronto, Ont.

Electric Club of New South Wales, Sydney, N.S.W. (P. B. Elwell, President; Oswald Haes, Vice-President)

Electric Club of Victoria, 9, Queen-st, Melbourne (L. Ellson, Hon. Secretary)

Electric Construction Company, Limited, 345, Flinders-lane, Melbourne, Victoria. (*See also* BRITISH DIVISION)

Electric Light and Motive Power Company, Limited, Electrical Engineers, 206, Russell-st, Melbourne Victoria

Electric Telegraph Society of New South Wales, P.O. Box 1139, Sydney, N.S.W. (E. C. Kraegen, Hon. Sec.)

Electric Wire and Fixings Company, Manufacturers of Electrical Apparatus, Westminster, British Columbia

Electrical Apparatus Company and Colonial Telephone Exchange, Manufacturing Electrical Engineers, 178, Little Collins-st East, Melbourne, Victoria

Electrical Institute of New South Wales, 52, Phillip-st, Sydney, New South Wales.

Electrical Machine Company, Manufacturers of Electrical Apparatus, 34, Queen-st, Melbourne, Victoria

Electrical Material and Lighting Company, Limited, Electric Light Contractors and Dealers in Electrical Apparatus, 22, Bridge-st, Sydney, N.S.W. (Percy Rutledge, Managing Director; G. D. Hamilton, Superintending Engineer)

Ellery, R. L. J., C.M.G., F.R.S., Government Astronomer and Examiner in Electricity and Magnetism, School of Mines, Ballarat, Victoria

Elliot & Phin, Electrical Engineers and Contractors, Brantford, Ont.

Ellson & Co, Consulting, Civil and Electrical Engineers, 9, Queen-st, Melbourne, Victoria; and at Adelaide, South Australia. (*Farad Melbourne, 1138*)

Elmore, J. O. S., A.M.I.C.E., Electrical Engineer, Eastern Electric Light Co, Sirdars-mansions, Bombay

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Grace, C. H., The Club, Hongkong
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Gunn, J. R., 456, Spencer-st, Melbourne, Victoria
Haes, Oswald, c/o Brush Electrical Engineering Company, Limited, 61, Queen-st, Melbourne, Victoria; and Sydney, New South Wales
Hamilton, G. D., Electric Material and Lighting Company, 22, Bridge-st, Sydney, N.S.W.
Harrison, H., Crompton Electric Supply Company of Australia, Limited, 193, Clarence st, Sydney, New South Wales
Hart, J., 266, Russell-st, Melbourne, Victoria
Higgins, George, Pitts-bldgs, 476, Collins-st Melbourne
Hillyer, R., 97, Bathurst-st, Sydney, N.S.W.
Human, Edwin, Halifax House, Robinson-st, Cinnamon-gdns, Colombo, Ceylon
Ireland, Geo., Durban. Natal, South Africa
Jamieson, M. B., 31, Queen-st, Melbourne, Victoria
Jones, Robert Clay, Moss Bank, George-st, Dunedin. New Zealand
Joseph, Major R. E., 12, Wrexham-rd, Windsor, Victoria
Knudson, A. A., Eastern Electric Company, St. John, New Brunswick
Kopsch, Charles F. G., 8, Bridge-st, Sydney, New South Wales
Kynoch, James, Canadian General Electric Company, Limited, 63-69, Front-st West, Toronto, Ont.
Lee, Bert C., Ottawa Street Railway Company, Ottawa, Ont.
Lemon, Charles, Ph.D., Superintendent of Telegraphs, Wellington, New Zealand
Leofred, A., Quebec, and Montreal, Canada
McFarlane, L. B., Bell Telephone Company of Canada, Montreal, Quebec

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McLeod, J., Grahamstown, South Africa
McMasters, J., Ridgetown, Ont., Canada
MacRitchie, Jas., C. E., Singapore, Straits Settlements
Mahler, W., 120, Russell-st, Melbourne, Victoria
Marple, L. E., Montreal Park and Island Railway, 17, Place d'Armes Hill, Montreal
Martyn, E., Brush Electrical Engineering Company, Limited, 56, Margaret-st, Sydney, N.S.W.
Master, Ardesheer Burjorji, 679, Tardeo, Bombay
Milton, S., 219, Queen-st, Melbourne, Victoria
Moore, B. L., Crompton Electric Supply Company of Australia, Limited, 193, Clarence-st, Sydney, New South Wales
Morton, Chas., Temple Electric Company, Montreal, Quebec
Mosely, Charles, North Toronto Council, North Toronto, Ont.
Moules, G. B., 187, Castlereagh-st, Sydney, N.S.W.
Murray, Lee L., 54, Market-st, Melbourne, Victoria
Murray, Cecil L., 60, Market-st, Melbourne, Victoria
Neal, A. E., Resident Engineer, Electric Light Works, Rockhampton, Queensland
Oxlade, Robert, Wheatear, Bourke-st, Sydney, New South Wales
Page & Wilkinson, Welland, Ont., Canada
Parker, A. C., Hobart Electric Tramway, Hobart, Tasmania
Patterson, John, Hamilton Radial Electric Railway Company, Hamilton, Ont., Canada
Pell, F. Bennett, c/o Messrs. Edlin & Stevenson, P.O. Box 199, Cape Town, South Africa
Peirce, Duncan J., 60 Market-st, Melbourne, Victoria
Revell, F., St. Thomas Gas Company, St. Thomas, Ont.
Reynolds, F. H., 156, St. James-st, Montreal
Ritchie, Hazen, 235, Metcalfe-st, Ottawa, Ont.
Robertson, W. A., 418, Collins-st, Melbourne, Victoria
Rosebrugh, T. R., B.A., School of Practical Science, Toronto, Canada
Ross, A., Gipp-st, Brisbane, Queensland
Ross, Norman J., Canadian General Electric Company, 350, Main-st, Winnipeg, Manitoba
Ross, Robert A., Royal Electric Company, Montreal, Canada
Rowley, H., 346, Flinders-st, Melbourne, Victoria
Russell, A., 8, Campbell-st, Newton, Sydney, New South Wales
Rutledge, P., Electrical Material and Lighting Company, 22, Bridge-st, Sydney, N.S.W.
Rutherford, W. M., Canadian General Electric Company, Limited, Toronto, Ont., Canada
Ryley, W., New Australian Electric Company, Limited, Fink's-bldgs, cor. Elizabeth and Flinder's-streets, Melbourne, Victoria
Sanderson, G., Hong Kong Electric Company, Hong Kong
Scott-Moncrieff, K. A., Messrs. Kilburn & Co, Calcutta
Selby, George William, 99, Queen-st, Melbourne, Victoria
Selfe, Norman, 279, George-st, Sydney, N.S.W.
Sise, Charles, F., Bell Telephone Company of Canada, Limited, Montreal, Canada
Smith, D. L., New Australian Electric Company, Limited, Fink's-buildings, Melbourne
Smith, F., 15, Bank-st East, Melbourne, Victoria
Spike, Clarence J., Halifax, Nova Scotia
Standford, W., Government Telegraph Department, Cape Town, South Africa
Steele, J. J., 162, Elizabeth-st, Melbourne, Victoria
Stewart, F. F. (Thomas & Taylor), Bombay
Stillwell, C. E., 37, King-st West, Hamilton, Ont.
Stuart, Charles (Stuart & Dornbusch), 9, Farrell's-chambers, 72, King-st. Sydney, N.S.W.
Stuart-Hartland & Co, 31, Dalhousie-square, Calcutta
Stubbs, J. H., Crompton Electric Supply Company of Australia, Limited, 193, Clarence-st, Sydney, New South Wales
Suckling-Baron, A. I., Gulcher Electric Light and Power Company, Limited, and the New Zealand Electrical Syndicate, Wellington, New Zealand
Taylor, A. M., c/o Messrs. John Fleming & Co, Elphinstone Circle, Bombay
Thomas, G. E. V., Singapore, Straits Settlements
Thomas, Orlo V., A.I.E.E., Singapore, Straits Settlements
Thomson, D., Hamilton Electric Light and Power Company, Hamilton, Ont.
Thomson, R. W., Leigh-st, Adelaide, South Australia
Turnbull, Robert T., Custom House Quay, Wellington, New Zealand
Warren, S., 148, Little Collins-st, Melbourne
Warren, Prof. W. H., M.I.C.E., Sydney University Engineering School, Sydney, N.S.W.
Warsing, C. H., Brunswick-st, Brisbane, Queensland
Warton, Michael S., Port Broome, Western Australia
Webb-Watts, T., c/o Post Office, Albany, Western Australia
Wickham, W. H., Manager, Hong Kong Electric Company, Limited, Hong Kong
Winter, G. K., F.R.A.S., M.I.C.E., Madras Railway, Arkonam, India
Wright, James J., 54, Margaret-st, Melbourne, Victoria

ELECTRICAL ENGINEERS (MANUFACTURING).

Anderson (A. T.) & Co, 75, Adelaide-st East, Toronto, Ont., Canada
Austen Bros, 239, Hollis-st, Halifax, Nova Scotia
Australasian Electric Company, 61, Queen-st, Melbourne, Victoria
Beak & Tonks, Kents-bldgs, Adelaide, Brisbane, Queensland
Brady & Todd, 255½, Sussex-st, Sydney, N.S.W.
Brush Electrical Engineering Company, Limited, 61, Queen-st, Melbourne, Victoria; and 56, Margaret-st, Sydney, N.S.W.
Canada Electric Company Limited, Amherst, Nova Scotia
Canadian Electrical Construction, Manufacturing and Supply Company, Montreal, Canada
Canadian General Electric Company, 65–71 Front-st West, Toronto, Ont.

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Compagnie Electrique, St. Jean Baptiste, Montreal, Quebec
Cortlandt Electrical Manufacturing Company, Toronto, Ont, Canada
Crompton Electric Supply Company of Australia, Limited, 193, Clarence-st, Sydney, N.S.W.
Dominion Electric Company, Montreal, Canada
Dunn & Poole, 136, Swanston-st, Melbourne, Victoria
Frost & Shipham, 474, George-st, Sydney, New South Wales
Graham & Shannon, Clinton, Ontario, Canada
Harris (P.) & Co, 3, Dean's-place, Sydney, New South Wales
Hibbard Electric Manufacturing and Supply Company, Limited, 773, Craig-st, Montreal, Canada
Kartzmark & Bros, Hamilton, Ontario
Kingsbury (H. H.) & Co, 54, Margaret-st, Sydney, N.S.W.
Lanyon, Bryant & Co, 317, Little Collins-st, Melbourne, Victoria
Lewis, C. F., Baptist-lane, Little Collins-st, Melbourne, Victoria
Masters (W. H.) & Co, 104, Elizabeth-st, Melbourne, Victoria
Milsom (W.), & Co, Nelson-st, St. Kilda, Melbourne, Victoria
Montreal Electric Company, 302, St. James-st, Montreal
Moody, F. H., High-st, St. Kilda, Melbourne, Victoria
Moore (W.) & Sons, Meaford, Ont., Canada
Morrison, W. J., Syracuse, Ont., Canada
Moules, Mathieson and Wallace, 9, Mercantile-chambers, 187, Castlereagh-st, Sydney, N.S.W.
New Australian Electric Company, Limited, Fink's-bldgs, cor. Elizabeth and Farmer's-sts, Melbourne, Victoria
Palmer, Struthers & Edmiston, 475, Collins-st, Melbourne, Victoria
Parke & Lacey, 187-189, Clarence-st, Sydney, N.S.W.
Pascoe & Gosche, 343, Collins-st W., Melbourne, Victoria
Postlethwaite & Stevenson, Castle-st, Dunedin, New Zealand
Quintard & Packard, Toronto, Ontario ; and Vancouver, British Columbia
Ross & McKenzie, Winnipeg, Manitoba, Canada
Siemens & Halske (Berlin), 54, Market-st, Melbourne
Siemens Bros & Co, Limited (London), 54, Market-st, Melbourne
Smith Bros, 367, Little Collins-st, Melbourne, Victoria
Stacey (C. F.) & Co, Bathurst, New Brunswick
Toronto Electrical Works, 35, Adelaide-st West, Toronto, Ont, Canada
Trackson Bros, Kents-building, Adelaide-st, Brisbane, Queensland
Turville, Dixon & Kemp, 138, Queen-st, Melbourne, Victoria
Volkhart Bros., Bombay
Wadia (Nowrosjee) & Sons, Tardeo, Bombay
Webb, A. C. F., Post Office-chmbrs, Pitt-st, Sydney, N.S.W.
Western Electric Manufacturing Company, Sydney Exchange, Bridge-st, Sydney, N.S.W.
Williams (Jos.) & Co, Georgetown, Ontario
Wood Bros & Co, Petersham, Sydney, N.S.W.
WOODHOUSE & RAWSON UNITED, Limited, Sydney, N.S.W., &c. **See Advt., p. 55.** (*See also* BRITISH. CONTINENTAL AND AMERICAN DIVISIONS)
Wright & Garland, Carberry, Man., Canada

ELECTRICAL EXPERTS.

Legrand, C., Peterborough, Ontario
Selby, George William, 99, Queen-st, Melbourne, Victoria
Shaw, Wm. B., Montreal Electric Company, Montreal
Thomlinson, Henry, 19, Macquarie-place, Sydney, N.S.W.
Thomson, Fred., Montreal, Canada

ELECTRICAL INSPECTORS.

Filmer, W. D., Metropolitan and Southern Lines, Government Railways, Sydney, N.S.W,
Murray, Cecil L., Fire Underwriters' Association of Victoria, 60, Market-st, Melbourne

ELECTRICAL INSTRUMENT MAKERS.

Alexander (H. A.) & Co, 19, Macquarie-place, Sydney, N.S.W.
Macdonnell & Rodick, 262, George-st, Sydney, N.S.W.
Solomons & Co, 7, Government-place, Calcutta
Wagner, J. J., 63, Lonsdale-st, Melbourne, Victoria
Whitney Electrical Instrument Company, Sherbrooke, Quebec
Wood (W.) & Co, Melbourne, Victoria ; and Sydney, N.S.W.

ELECTRICAL SUPPLIES, MAKERS OF & DEALERS IN

Carroll Bros, 795, Craig-st, Montreal, Quebec
Chubb (H.) & Co, St. John, New Brunswick
Crosher, W., Electrical Depôt, Queen-st, Auckland, New Zealand
Dominion Electrical Manufacturing Company, 66, Adelaide-st, Toronto, Canada
Dwight, Lyman, Winnipeg, Manitoba, Canada
Electrical Material and Lighting Co, Limited, 22, Bridge-st, Sydney, N.S.W.
Henderson, C. W., cor. Bleury and Juror-sts, Montreal, Canada
Hibbard Electric Manufacturing and Supply Company, Limited, 773, Craig-st, Montreal, Canada
Holland Bros & Young, 1,740, Notre Dame-st, Montreal, Canada
Leslie (W.) & Co, 1, Chowringhee-rd, Calcutta
Mackintosh (John) & Sons, 307, 276 & 278, Pitt-st, Sydney, N.S.W.
Martin (C. A.) & Co, 765, Craig-st, and P.O. Box 1078, Montreal, Canada
Mount (E. C.) & Co, 766, Craig-st, Montreal, Quebec
Ness (T. W.) & Co, 749, Craig-st, Montreal, Canada
Pearson, E. W., 351-353, Little Flinders-st, Melbourne, Victoria

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Pyke, James W., St. François Xavier-st, Montreal
Reliance Electric Manufacturing Company, Waterford ; and Toronto, Ont., Canada
Robertson (James) & Co, Queen-st, Melbourne
Starr (John), Sons & Co, 2, 4 & 6, Duke-st, Halifax, Nova Scotia.
Thornberry (H. S.) & Co, 35, Adelaide-st West, Toronto, Canada

ELECTRICIANS (CONSULTING, &c.).

Ahearn, T., Ottawa, Canada.
Ashcroft, Edgar A., Flinders Lane, Melbourne, Victoria.
Badger, F. H., City Fire Alarm Telegraphs, Montreal, Canada
Bailey, A. J., Post Office, Point Durban, Natal
Balbi, J. Lewis, 18, Strada Mezzodi, Malta
Bayly, Brackenbury, Cape Town
Beall, S. W., Somerset-pl, Little Bourke-st, Melbourne, Victoria
Betts Lester B., India Rubber, Gutta Percha and Telegraph Works Company, Limited, 12, Government-place, Calcutta
Black, G., Great North-Western Telegraph Company, Hamilton, Ont.
Black, Prof. James Gow, M.A., D.Sc., Otago University, Dunedin, New Zealand
Booth, F., Secretary, Western Australian Mechanical and Electrical Institute, Perth, Western Australia.
Bowler, P., New Westminster, British Columbia (To the City)
Bowman, Fred. A., M.A., B.E., New Glasgow Electric Company, New Glasgow, Nova Scotia
BROWNE, R. JAMIESON, B.I.S.N. Company, Ltd, Howrah Dock, Howrah, Calcutta
Callendar, Prof. H. L., McGill University, Montreal, Canada
Callender, Romaine, Brantford Electrical Laboratory, Brantford, Ont.
Carey, Walter C., Eastern Telegraph Company, Gibraltar
Carrol, John, Eugene F. Phillips Electrical Works, St. Gabriel Docks, Montreal, Canada
Carus-Wilson, Prof. A., M.A., McGill University, Montreal, Quebec.
Chanteloupe, E., 587, Craig-st, Montreal, Quebec
Childs, A. E., B.Sc., Box 1957, Montreal, Quebec
Choquette, l'Abbé, M.A., St. Hyacinthe, Canada
Clarke, Geo. A., 46, McKenzie-st, Balmain, Sydney, New South Wales
Clarke, W. J., Toronto, Ont., Canada
Clayton, Alfred, Town Hall, Richmond, Melbourne, Victoria.
Clements, G. F., c/o Engineer for Existing Railways, Bridge-st, Sydney, N.S.W.
Close, A. J., Toronto, Ont., Canada
Cogswell, A. R., Illuminating and Motor Company, Limited., 34, Bishop-st, Halifax, Nova Scotia.
Corbitt, M. W., Messrs. T. W. Ness & Co, 749, Craig-st, Montreal
Crookes, Henry, A.R.S.U., Post Office, Mafeking, British Bechanaland, South Africa
Crump, W. C., 44, Castlereagh-st, Sydney, N.S.W.
Davidson, Alexander, Anglo-American Telegraph Company's Cable Ship "Minia," Halifax, Nova Scotia
Dell, J. J., Cameron-st, Launceston, Tasmania
Denham, J., Cape Government Railways, Salt River, near Cape Town, South Africa
Devitt, Thos., Eastern Telegraph Company, Ltd., Malta
Dewhirst, Thos. Y., South Australian Government Service, Glanville, South Australia
Dion, A. A., Chaudiere Electric Light and Power Company, Limited, Ottawa, Ontario
Dodd, Maynard, Anglo-American Telegraph Company's Cable Ship "Minia," Halifax, Nova Scotia
Dornbusch, Ernest G. (Messrs. Stuart & Dornbusch), 9, Farrell's-chambers, 72, King-st, Sydney, N.S.W.
Dowson, Harold, Department of Working Railways, Perth, Western Australia
Edkins, Albert E., 22, Agnes-st, Toronto, Canada
Ellery, R. L. J., C.M.G., F.R.S., School of Mines, Ballarat, Victoria
Ernest, Chas. F., New Hamburg, Ont., Canada
Erskine, Edward J., Brush Electrical Engineering Company, Limited, 56, Margaret-st, Wynyard-sq, Sydney, N.S.W.
Everett, Henry, Toronto Street Railway Company, Toronto, Ontario
Farr, C. C., St. Paul's College, The University, Sydney, N.S.W.
Finlay, W. H., M.A., F.R.A.S., Royal Observatory, Cape Town, South Africa
Fisk, H. O., Electric Light Company, Peterborough, Ontario
Foster, L., 42, Margaret-st, Wynyard-sq, Sydney, N.S.W.
Gisborne, Hartley, Government Telegraph Service, Department of Public Works of Canada, Qu'Appelle Station, Assiniboia District, N.W. Territories, Canada
Gagnon, J. E., 286, St. Joseph-st, Quebec
Glass, C. E., 90, Collins-st, Melbourne, Victoria
Hagar, C. W., 54, Wellington-st, Montreal
Harrison, W. Stuart, Manager, China and Japan Telephone Company, Limited, Praya Central, Hong Kong
Hepburn & Spruson, 169, King-st, Sydney, N.S.W.
Hick, T. L., 139, Church-st, Toronto, Ontario
Hoare, Arthur, Messrs. John Fleming & Co, Elphinstone Circle, Bombay
Hogg, Evelyn G., B.A., Trinity College, Melbourne, Victoria
Hoyt, Adam H., M.D., Sherbrooke, Quebec, Canada
Hunter, J., 88, Princess-st, St. John, New Brunswick
Jackson, Dr. M. T., M.A., Arts College, Karachi, India
Jenvey, Henry W., Government Telegraph Department, General Post Office, Melbourne, Victoria
Jones, J. C. D., Eastern Extension Telegraph Company, Singapore
Kernot, Prof. W. C., M.A., C.E., University of Melbourne, Melbourne, Victoria
Lawless, W. H., Oriental Telephone and Electric Company, Limited, 37, Errahbauloo Chetty-st, Madras

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Lewis, C. F., Baptist-lane, Little Collins-st, Melbourne, Victoria
Macdonnell, Prof. A., B.A., Civil Engineering College, Seeòpore, near Calcutta
McEwan, W., 26, Peel-st, N. Melbourne, Victoria
McMicking (R. B.) & Co, Victoria, British Columbia
Mathews, H. M. S., Settlement Office, Bassim, Burmah
Mathieson, J., Albert-st, Brisbane, Queensland
Morris, F. E., Charlottetown, Prince Edward Island
Myers, W. S., 57, Granville-st, Halifax, Nova Scotia
Napier, Geo., Fergus, Ont, Canada
Nolan, W. J., Kimberley-st, Cape Town
Noake, W. M. (Messrs. John Fowler & Co, Leeds, Limited), Elgin-bldgs, Sydney, N.S.W.
Olsen, M., Wickham-st, Brisbane, Queensland
Pierce, Walter H., 190, Orchard-rd, Singapore
Raper, F., Bombay Telephone Company, Limited, Elphinstone Circle, Bombay
Rutherford, F. N., Bathurst, N.S.W.
Scott, D. Bryce, International Railway of Canada, Moncton, New Brunswick
Scott. John D., New Zealand Railway Company, Oamaru, New Zealand
Selman, Prof. D. C., Technical College, Harris-st, Ultimo, Sydney, N.S.W.
Smith. Alfred Mica, B.Sc., B.A., School of Mines Ballarat, Victoria
Smythe, W. C., Postal Telegraphs, Wellington, New Zealand
Snowdon, J. P., Hawthorn-rd, Caulfield, Victoria
Sutton, Henry, 131, Elizabeth-st, Melbourne, Victoria
Tatham, George, 25, Clarence-st, and 11, York-lane, Sydney, N.S.W.
Tavaria. H. K., B.Sc., Victoria Jubilee Technical Institute, Parei, Bombay
Thompson, W. G. MacN., Sault Ste. Marie Canal, St. Catherine's, Ont., Canada
Thomson, Fred., Montreal, Canada
Threlfall, Prof. Richard, Sydney University, Sydney, New South Wales
Tillet, G. A., Harbour and Rivers Department, Phillip-st, Sydney, N.S.W.
Tournay-Hinde, A. W., Tallooma, Edgecliff-rd, Woollahra, Sydney, N.S.W.
Trackson Bros, Adelaide-st, Brisbane, Queensland
Trott, Samuel, Anglo-American Telegraph Company's c.s. "Minia," Halifax, Nova Scotia
Unbehaun, C., Government Telegraph Service, Adelaide, South Australia
Walker, C., Government Railway, Port of Spain, Trinidad
White, Geo. Montagu, Thomson-Houston International Electric Company, Kingston, Jamaica
Wickens, A. M., Ontario Parliament-bldgs, Toronto, Ont.
Williamson, A. F., 255, George-st, Melbourne, Victoria
Wolfe, Augustus, Post and Telegraph Office, Clunes, Brunswick, Victoria
Wray, Leonard, jun., Perak Museum, Perak, Straits Settlements

ELECTRICIANS (MANUFACTURING).

Abell, Huot & Co, St. Casimir, Quebec, Canada
Brownley Electric Manufacturing Co, St. John, New Brunswick
Canada Electric Company, Amherst, Nova Scotia
Cashel, Barter & Co, 528, Collins-st, Melbourne, Victoria
Connell Bros, Woodstock, New Brunswick
Connor & Green, 6, Eastern Arcade, Melbourne
Crow, John, 147, Collins-st, Melbourne, Victoria
Dey, Sil & Co, 20, Lall Bazaar-st, Calcutta
Draper (Thos. T.) & Co, 144, Elizabeth-st, Melbourne, Victoria
Edwards (J. E.) & Co, 138, Little Collins-st, Melbourne, Victoria
Frame (Geo.) & Co, 29, Colborne-st, Toronto
Frost and Shipham, 474 and 587, George-st, Sydney, N.S.W.
Furst & Co, 163, Queen-st, Melbourne, Victoria
Gailey, W. G., Charlotte-place and Harrington-st, Church-hill, Sydney, N.S.W.
Gisborne, Francis H., Department of Justice, Ottawa, Canada.
Greenleaf (O. C.) & Son, Belleville, Ont.
Grimshaw, J. W., Australian Club, Macquarie-st, Sydney, N.S.W.
Hagan & Blakeman, Mount-st, North Sydney, N.S.W.
Hecksher & Baynes, 94, Chapel-st, Praturan, Melbourne, Victoria
Hout, John, 264, Russell-st, Melbourne, Victoria
Hyde (T. C.) & Son, Green and Swan-sts, Richmond, Victoria
Ironmongers' Manufacturing Company, 276, Little Lonsdale-st, Melbourne, Victoria
Jost (C.) & Co, Sirdars Mansions, Apollo Bunder, Bombay
Knight (J.) & Co, off 344, Little Collins-st, Melbourne, Victoria
Lightfoot & Urquhart, 125, Queen-st, Brisbane, Queensland
Mitchell (R.) & Co, 672, Craig-st, Montreal
Murray (James) & Weir (W. H.), 11, Dalhousie-sq, Calcutta
Neuenkirchen, H., Gawler-place, Adelaide, South Australia
N.S.W. Master Plumbers & Gasfitters' Co-operative Company, 379, Pitt-st, Sydney, N.S.W.
Scott, E. W., 332, Pitt-st, Sydney, N.S.W.
Smith, Alfred, 130, Victoria-st, Christchurch New Zealand
Taylor & Oakley, Tuam-st, Christchurch, New Zealand
Temple Electric Company, Montreal, Quebec
Watt & Co, Stuart-st, Dunedin, New Zealand

ENGINES (STEAM) MAKERS OF.

Beckett (F. G.), Engine Company, Hamilton, Ont.
Robb Engineering Company, Limited, Amherst, Nova Scotia

ENGINEERS, CONSULTING.

Cooke, John Herbert, King William-st, Adelaide, South Australia

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Cundy, W. M., Over 93, Collins-st, Launceston, Tasmania
Ellson & Co, 9, Queen-st, Melbourne, Victoria
Grant, C. H., Hobart Electric Tramway Company, Tasmania
James, C. Wordsworth, Club-chmbrs, Hobart, Tasmania
Murzban, Khan Bahadur, M.C., C.I.E., Bombay (To the Municipality)
Ross, C. J., B.Sc., 105, Pitt-st, Sydney, N.S.W.
Stuart-Hartland & Co, 31, Dalhousie-sq, Calcutta

ENGINEERS, GENERAL.

Austral Otis Engineering Company, Limited, Moray-st, South Melbourne, Victoria ; and Sydney, N.S.W.
Fowler John & Co (Leeds), Limited, Elgin-bldg, Wynyard-sq, Sydney, N.S.W.
Hudson Bros, Limited, Clyde, near Granville
King (John) & Co, Limited, 30, Strand-rd, Calcutta
Scott & Clark, Launceston, Tasmania
Thomson (T. E.) & Co, Limited, 9, Esplanade-row East, Calcutta

ENGINEERS, HYDRAULIC.

Kennedy (Wm.) & Sons, Owen Sound, Ont.
Pearson, E. W., 351-353, Little Flinders-st, Melbourne, Victoria
Wilson (J. C.) & Co, Glenora, Ont.

ENGINEERS, MECHANICAL.

(*See also* **Engineers, General.**)

Cooke, John Herbert, King William-st, Adelaide, South Australia
Muntz, Bage and Muntz, 349, Collins-st, Melbourne, Victoria
Seitz, Edward, 414, Market-bldgs, Flinders-lane West, Melbourne

ENGINEERS, MINING.

(*See also* **Engineers, General.**)

Wadia (Nowrosjee) & Sons, Tardeo, Bombay

IMPORTERS OF ELECTRIC STORES.

Briscoe, Drysdale & Co, 397, George-st, Sydney, N.S.W.
Hipwood Bros, Eagle-st, Brisbane, Queensland
Hoskins, G. & C., Hay and Victoria-streets, Sydney, N.S.W.
Pearson, E. W., 351 & 353, Little Flinders-st, Melbourne, Victoria
Silberberg (E.) & Co, 18, Barrack-st, Sydney, N.S.W.
Train, Weston & Robinson, Flinders-bldgs, 310, Flinders-st, Melbourne, Victoria

INCANDESCENT LAMPS, MAKERS OF.

Canadian General Electric Company, 65-71, Front-st West, Toronto, Ontario, and at Quebec, &c.
Notman, J., 28, Little Collins-st E., Melbourne, Victoria
Packard—Packard Lamp Co, Limited, 96-100, King-st, Montreal
Sawyer-Man Electric Company, Montreal

INSULATING MATERIALS, MAKERS OF.

General.

LAKE GIRARD MICA SYSTEM, 504, Besserer-st, Ottawa, Ont., Canada. **See Advt., p. 595**

MICA MERCHANTS AND DEALERS (*see also* Insulating Materials, Makers of).

LAKE GIRARD MICA SYSTEM, 504, Besserer-st, Ottawa, Ont., Canada. **See Advt., p. 595**

PATENT AGENTS AND EXPERTS.

COOKE, JOHN HERBERT, King William-st, Adelaide, South Australia
Newman (W.) & Co, 4, Dalhousie-sq, Calcutta
Phillips, Ormonde & Co, 169, Queen-st, Melbourne, Victoria

PUBLICATIONS, ELECTRICAL.

Canadian Electrical News and Steam Engineering Journal (monthly) 106-108, Confederation Life-bldg, Toronto ; and at Montreal, Canada (Price $1 per ann.)
Canadian Engineer (monthly), 62, Church-st, Toronto, Ont. (Ann. sub., $1.00)

SCHOOLS AND COLLEGES.

Ballarat School of Mines, Industries and Science (in the University of Melbourne), Ballarat, Victoria
Bombay University, Mayo-rd, Bombay
Calcutta University, Calcutta
Civil Engineering College, Seebpore, Bengal
College of Science, Poona, India
Dalhousie College and University, Halifax, Nova Scotia
McGill University, Montreal, Canada
Nova Scotia Institute of Science, Halifax, Nova Scotia
School of Practical Science, Toronto, Ont, Canada
Sydney University, Sydney, New South Wales
Thomason College, Roorkee, India
Trinity College, Melbourne, Victoria

SOCIETIES AND INSTITUTIONS.

Canadian Electrical Association, 106-108, Confederation Life-bldg, Toronto, Ont.
Canadian Institute, Toronto, Canada
Electric Club of New South Wales, Sydney, New South Wales
Electric Telegraph Society of New South Wales, Sydney, N.S.W.
Engineering Association of New South Wales (Secretary, J. S. Fitzmaurice, Electric Light Branch, Government Telegraph Department), Sydney, N.S.W.
Queensland Institute of Mechanical Engineers, Courier-bldg, Brisbane, Queensland
Royal Society of Victoria, Melbourne, Victoria
Victorian Institute of Engineers, Temperance-bldgs, Swanston-st, Melbourne, Victoria
Victorian Railways Electrical Society, Spencer-st, Melbourne, Victoria
West Australian Mechanical and Electrical Institute, Perth, Western Australia

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TELEGRAPH AND CABLE COMPANIES.

ANGLO-AMERICAN TELEGRAPH COMPANY, Limited, corner St. François Xavier and St. Sacrament-sts, Montreal, Quebec (*See also* BRITISH DIVISION). **See Advt., p. cxxvii.**
Canadian Pacific Railway Company's Telegraphs, Montreal, Canada
Dominion Telegraph Company, 18-20, Toronto-st, Toronto, Canada
Great North-Western Telegraph Company, 17, Wellington-st East, Toronto, Canada
Montreal Telegraph Company, Montreal, Canada
North American Telegraph Company, Ottawa, Ontario, Canada
Pacific Postal Telegraph Cable Company, Montreal, Canada

TELEGRAPH ENGINEERS.

(Telegraph Superintendents, Managers, and Inspectors will be found in next column)

Allen, J. J., Government Telegraphs, Calcutta
Andrews, W., M.B., Government Department, Melbourne, Victoria
Berrington, T. D., Indian Government Telegraphs, Dacca, Madras
Black, G., Great North Western Telegraph Company, Hamilton, Ont.
Bradford, John R., Telegraph Office, Brisbane
Burne, Oldbury, Indian Government Telegraphs, Umballa, India
Butcher, S., Indo-European Telegraph Department, Jask, India
Campbell, Walter D., Government Telegraph Department, Ballarat, Victoria
Coode, J. M., Indian Government Telegraphs, Nagpur
D'Aranjo, P., Thaepeng, Perak, Straits Settlements
Darby, J. C. H., Eastern Extension Telegraph Company, Singapore
Devitt, Thos., Eastern Telegraph Company, Malta
Dickenson, W., Anglo-American Telegraph Company, Heart's Content, Newfoundland
Dircks, A. A., Electric Telegraph Department, G.P.O., Sydney, N.S.W.
Doyle, James D., Victorian Railways, Melbourne
Duff, C. F., Postal Telegraph Department, St. Anne's Bay, Jamaica
Earle, Edward, Anglo-American Telegraph Company, Heart's Content, Newfoundland
Edgar, Henry, Government Telegraph Department, Victoria
Edwards, J. P., Government Telegraphs, King William's Town, South Africa
Gell, John, Governments Telegraphs, Wellington, New Zealand
Gillan, John D., Government Telegraph Department, Melbourne, Victoria
Goodhall, H. C. A., Indian Government Telegraphs, Lahore
Green, Thos., Inspector Postal and Telegraph Service, Melbourne, Victoria
Harrhy, E. E., Secretary's Office, G.P.O., Cape Town, South Africa
Howard, T., Telegraph Electrical Society, Melbourne, Victoria
James, Charles S., Indian Government Telegraphs, Indore
Jenvey, H. W., Telegraph Department, Melbourne, Victoria
Luke, S. P. W. V., C.I.E., Indian Government Telegraphs, Calcutta
Maginnity, Andrew T., Post and Telegraph Department, Nelson, New Zealand
McPherson, J., Telegraph Department, Cape Town
Marsac, F. R. de, Indian Government Telegraphs, Alipore
Mercer, Frank, Indian Government Telegraph Department, Madras
Morrison, Albert Edward, Anglo-American Telegraph Company, Charlottetown, Prince Edward Island, Canada
Murray, K. L., Victorian Railways, Baring Chambers, Market-st, Melbourne, Victoria
Nelson, J. Y., Postal Telegraph Department, G.P.O., Sydney, N.S.W.
Papafio, S. W. Q., H.M. Government Telegraphs, Accra, West Coast of Africa
Pigott, R. E. P., Madras Railway, Arkonam
Pitman, C. E., C.I.E., Indian Government Telegraphs, Calcutta
Saunders, J. Brewer, Oriental Telephone and Electric Company, Limited, Calcutta
Simpson, M. G., Indian Government Telegraphs, Trichinopoly, India
Sivewright, Sir James, K.C.M.G., Eastern & South African Telegraph Company, Limited, Cape Town
Smibert, Geo., Telegraph Department, Melbourne, Victoria
Unbehaun, C., G.P.O., Adelaide, South Australia
Warton, Michael S., Port Broome, West Australia
Wilson, S. Newcome, Indo-European Telegraph Department, Persian Gulf Section, Bushire, India
Wright, Thomas, Eastern Telegraph Company, Malta

TELEGRAPH (&c.) SUPERINTENDENTS, MANAGERS, AND INSPECTORS (GOVERNMENT AND COMPANIES').

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Andrews, M. S., Accra, Gold Coast, West Africa (Director)
Baxendale, A. S., Selangor, Straits Settlements
Bold, Edward H., A.M.I.C.E., Napier, New Zealand (Inspector)
Bowden, F. P., Government Telegraphs, Hobart, Tasmania, (Manager)
Bourne, Robert O., Postal and Telegraph Department, Bowen, Queensland, (General Inspector)
Brooke, W. R., C.I.E., Indian Government Telegraphs, Calcutta. (Director-General)
Browning, Walter W., Eastern Extension Telegraph Company, Nelson, New Zealand
Buckland, R. G. S., Eastern Extension, Australasia and China Telegraph Company, Port Darwin, South Australia
Caine, G. W., Eastern and South African Telegraph Company, Limited, Seychelles
Carey, Walter C., Eastern Telegraph Company, Gibraltar (Assistant Superintendent)

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Cassidy, Thomas, Eastern and South African Telegraph Company, Cape Town, South Africa
Ceffala, A. G., African Direct Telegraph Company, Sierra Leone, West Africa
Chadwick, J., Government Telegraphs, Natal, South Africa
Charles, G. G., Indian Government Telegraphs, Calcutta
Chevallier, C., Eastern Telegraph Company, Aden
Colley, Benjamin W., Commercial Cable Company, Hazel Hil, Nova Scotia
Cormac, Chas., Government Telegraphs, Kuala Lumpor, Straits Settlements (Chief Inspector)
Cowl, T. H., Bowen, North Queensland
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Dickenson, S. S., Commercial Cable Company, Limited, Canso, Nova Scotia
Dunbar, Wm., Government Telegraphs, Cape Town, South Africa
Dwight, H. P., Great North-Western Telegraph Company, Toronto, Canada
Duff, B., Cape Government Telegraphs, Cape Town
Fenn, Samuel, Direct United States Cable Company, Halifax, Nova Scotia
French, S. R., Postmaster-General, G.P.O., Cape Town.
Furby, W. S., Government Telegraphs, Auckland, New Zealand
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Gott, D. W., Eastern Extension, Australasia and China Telegraph Company, Penang
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Henry, Robert, Government Telegraphs, Hobart, Tasmania
Himbury, W. H., African Direct Telegraph Co, Brass, West Africa
Holmes, Wm. A., Victorian Railways, Melbourne, Victoria
Hosmer, Chas. R., Canadian Pacific Railway Company's Telegraphs, P.O. Box 1956, Montreal, Canada. (General Manager)
Hutchinson, S. H. C., Indian Government Telegraphs, Central Telegraph Office, Bombay
James, T. C., Anglo-American Telegraph Company, Charlottetown, Prince Edward Island
James, Thos. Reynolds, Post and Telegraph Department, Melbourne, Australia (Secretary)
Jamieson, Hugh, African Direct Telegraph Company, Limited, Bonny, West Africa
Jones, W. C. Nigel, Indian Government Telegraphs, Jubbulpore
Judd, Walter, Eastern Extension Telegraph Company, Hong Kong. (Manager in China)
Lane, J. H., Indian Government Telegraphs, Calcutta (Deputy Director-General)
Lemon, C., Ph.D., Government Telegraphs, Wellington, New Zealand
Lundy, Chas. William, Direct United States Cable Company, Halifax, Nova Scotia
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Meddings, W. G., Christchurch, New Zealand (Inspector)
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Portelli, Robert, Eastern Telegraph Company, Malta (Manager)
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Reynolds, C. H., Government Telegraph Department, Calcutta. (Director of Traffic Branch
Saliba, J., Eastern Telegraph Company, Perim
Segrave, Wm., Eastern Extension, Australasia and China Telegraph Company, Flinders, Victoria
Sholl, R. A., Government Telegraphs, Perth, Western Australia
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Smith, Sidney, Electric Telegraph Department, Brisbane, Queensland
Spratt, G. O., Eastern Telegraph Company, Gibraltar
Squier, J. E., Eastern Extension, Australasia and China Telegraph Company, La Perouse, near Sydney, New South Wales
Stacey, Geo. B., Eastern Telegraph Company, Bombay, India
Taylor, W. G., Eastern Extension, Australasia and China Telegraph Company, Singapore. (General Manager)
Todd, Sir Chas., K.C.M.G., Government Telegraphs, Adelaide, South Australia (Postmaster-General)
Vane, F. W., G.P.O., Colombo, Ceylon (Postmaster-General)

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Webb, Geo. R., Great Indian Peninsular Railway, Byculla, India
Wilson, Harry C., Government Telegraphs, Kingston, Jamaica
Wilson, W., G.P.O., Sydney, N.S.W.
Woolward, R. S., African Direct Telegraph Company, Bathurst, West Africa

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Bombay Telephone Company, Elphinstone Circle, Bombay, India
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Les lecteurs de "THE ELECTRICIAN" appartiennent à toutes les classes de l'Electricité et sont répandus dans l'univers entier, ce qui explique la grande circulation de ce journal. Les volumes finissent en Mai et en Novembre, et forme des revues d'un plus grand intérêt et les plus complètes sur l'Electricité et ses applications publiées dans le monde entier.

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FOREIGN GOVERNMENTS' ELECTRICAL DEPARTMENTS.

One of the principal drawbacks experienced in the endeavour to introduce new inventions, &c., to the notice of the heads of Government departments is the difficulty of selecting from the lists usually given the proper persons to be approached. With the object of rendering assistance, we have introduced the following authentic information for the benefit of patentees and manufacturers of instruments, apparatus, and plant who may desire to introduce electrical goods.

We are greatly indebted to the gentlemen who have so readily given us their assistance in procuring the particulars given.

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44, RUE DE RENNES, PARIS.

(The Société Internationale des Électriciens was founded in 1883, and definitively constituted at a general meeting of members on November 15th of that year.)

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"THE ELECTRICIAN"

ELECTRICAL TRADES' DIRECTORY.

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ALPHABETICAL SECTION.

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An asterisk (*) *prefixed to a name indicates that a* BIOGRAPHICAL SKETCH *appears at the end of the book.*

Advertisers *in* THE DIRECTORY *will find* **prominent reference** *made to their Advertisements, and to the pages in which they occur.*

— A —

Abadie, A., Electrician, 36, Rue Etienne-Marcel, Paris

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Abendroth & Co, Kommandit-Gesellschaft, Electrical Engineers and Contractors, 12, Bischstrasse, Hamburg

Abler, Haas & Angerstein, Electrical Engineers, 18, Kommandentenstrasse, Berlin, S.W.

Aboilard (G.) & Co, Telephone Apparatus Makers, 46, Avenue de Breteuil, Paris

Aboilard, Louis, Electrical Engineer, 33, Rue des Tournelles, Paris

Académie des Sciences, Institut de France, 23, Quai Conti, Paris

Académie des Sciences Industrielles, des Arts et des Manufactures, 3, Rue Déchargeurs, Paris

Académie royale des Sciences, Lettres et Beaux-Arts, 1, Rue Ducale, Brussels

Académie universelle des Sciences et des Arts industrielles, 53, Rue d'Angleterre, Brussels

Accumulateur Fulmen (soc. anon.) Makers of the Tommasi Accumulator, 39, Rue de l'Arcade, Paris; and (Works) 16 and 18 Quai de Clichy, Clichy

L. Rouart ... ... Manager
Donato Tommasi ... Consulting Engineer

Accumulatorenfabrik Aktiengesellschaft (Generalrepresentanz Wien), Makers of the Tudor Accumulator, Bellariastrasse 8, Vienna I.; and (Works) Baumgarten-a-d. Wien. (*Accumulator Vienna*)

Accumulatorenfabrik Aktiengesellschaft, Makers of the Tudor Accumulator, Hagen i. W., and 31, Karlstrasse, Berlin, N.W.

Accumulatoren Fabrik Aktiengesellschaft Zweigniederlassung in Oerlikon, Manufacturers of Storage Batteries, Oerlikon, bei Zürich

Accumulatorenfabrik System Boese-Lütcke, Accumulator Makers, 32, Andreastrasse, Berlin

Accumulatoren-Werke "Germania," H. Lehmann & Co, Accumulator Makers, 23, Spenerstrasse, Berlin, N.W.

Accumulatoren-Werke Hirschwald, Schäfer & Heinemann, Accumulator Makers, 69, Lindenstrasse, Berlin

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Adams, Charles, Representative in Belgium of Messrs. Saxby and Farmer, 143, Boulevard de la Senne, Brussels

Adda (D.) & Sons, Electrical Engineers, Alexandria

Adelson, Hans von, Electrician, 6, Kurfürstendamm, Berlin, W.

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Adler (H. W.) & Cie, Electrical Engineers, Makers of Pocket Accumulators, &c., 34 and 36, Rothenhofgasse, Vienna, X. (*Adlerkomp Vienna, 1433*)

Adrian, F., Maker of Electric Wires and Cables, 24, Wasserthorstrasse, Berlin, S.

Aerts, —, Director of the Public Lighting, Rue de la Presse, Brussels

Agémian Frères, Agents for Electrical Apparatus, 14, Ziver bey Han, Constantinople

Agémian, Mighirditch, Chief of the Engineers' Office, Turkish Posts and Telegraphs, Constantinople

Agthe, Karl, Electrical Engineer, 4, Chausseestrasse, Berlin, N.

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Ahlsell, Ad., Chief Engineer, Stockholms Electricitets-verk, Stockholm

Aicher & Eberhardt, Electrical Apparatus Makers, 138, Silberburgstrasse, Stuttgart, Germany

Aix-la-Chapelle Iron and Steel Company, Telegraph Wire Manufacturers, Rothe Erde, near Aix-la-Chapelle, Prussia

Aktie-Bolag Electron, Electrical Engineers and Manufacturers of Electrical Apparatus, Gothenburg, Sweden

Aktien-Gesellschaft Butzke, Electrical Apparatus Makers, 12, Ritterstrasse, Berlin. (*Butzke Metallindustrie Berlin*)

Aktien-Gesellschaft für den Bau und Betrieb elektrischer Anlagen, Electrical Engineers and Contractors, Bockenheim, Frankfort-on-the-Main

Aktien-Gesellschaft für Chemische Industrie, Manufacturers of Muriate of Ammonia (Sal Ammoniac) for Batteries and Acids for Accumulators, Mannheim, Germany. Works: Rheinau, Baden. (*Chemie Mannheim*)

Aktien-Gesellschaft Dynamit Nobel, Manufacturers of Electric Fuses and Blasting Apparatus, 11, Walfischgasse, Vienna I. (*Dynamitnobel Wien*)

Aktien-Gesellschaft "Elektra," Electrical Engineers and Contractors, Bamberg, Germany

Aktien-Gesellschaft für elektrische Glühlampen, Makers of Incandescent Lamps, Husza-utcza, 7, Budapest VII.

Aktien-Gesellschaft Escher, Wyss & Co, Electric Light Engineers and Contractors, Zürich, Switzerland; Ravensburg, Wurtemberg; and Leesdorf, near Vienna

Aktien-Gesellschaft für Fabrikation von Broncewaaren und Zinkguss, Makers of Electric Light Fittings, 9, Wasserthorstrasse, Berlin, S.

Aktien-Gesellschaft für Glasindustrie (vorm. Fried. Siemens), Manufacturers of Glass for Electrical Purposes, &c., 43, Freibergerstrasse, Dresden; and Vienna

Aktien-Gesellschaft Mix & Genest, Electrical Engineers, Telephon-, Telegraphen- und Blitzableiter-Fabrik, 14a, Neuenburgerstrasse, Berlin, S.W.; and at Hamburg. (*Genest Berlin, 1444; Genest Hamburg*). (*See also* International Electric Company *in* British Division.)

Aktien-Gesellschaft für Monierbauten (vorm. G. A. Wayss & Co), Makers of the Monier Underground Circuit, 97, Alt Moabit, Berlin, N.W.

Aktien-Gesellschaft für Patent Chromakkumulatoren, G. E. Heyl, Makers of Chromic Batteries, 101, Leipzigerstrasse, Berlin, W.

Aktien-Gesellschaft Schaeffer & Walcker, Makers of Electric Light Fittings, 18, Lindenstrasse, Berlin, S.W.

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G. Wenstrom (Westeras) Director
Jonas Wenstrom .. .. Chief Electrician
Ernst Danieleon .. .. Superintendent

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Anglo-Portuguese Telephone Company, Limited, 60, Travessa de Sta. Justa, Lisbon; and 14, Rua de Ferreira Borges, Oporto. (*See also* BRITISH DIVISION)

Anglo-Roman Illumination Company, Electric Light Engineers and Contractors, Rome. (Signor Mengarini, Electrician)

Annales Télégraphiques (bi-monthly), 45, Quai des Grands Augustins, Paris. (Ann. sub., France, 12 fr.; Postal Union, 15 fr. = 12s.)

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Antwerp Telephone and Electrical Works, Electrical Engineers, Berchem, Antwerp. (*Electrical Antwerp*)

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Association Française pour l'Avancement des Sciences, Hotel des Sociétés Savantes, 28, Rue Serpente, Paris. (M. Mascart, Président; M. Gariel, Secretary)

Association des Ingénieurs Electriciens sortis de l'Institut Electro-Technique Montefiore, Liége.

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E. Franken ... ... President of Committee
Gustave L'Hoest ... Gen. Secretary

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Association Suisse des Electriciens — *see* Schweizerischer Elektrotechnicker Verein

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Bartelmus (Aug.) & Witte, Makers of Electric Light Fittings, 15, Spitalwiese, Brünn.

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Bartels (Franz) & Co, Electric Light Engineers and Contractors, Dantzig

Bartzsch & Co, Electric Light & Power Engineers and Contractors, 11, Stephanstrasse, Berlin, N.W.

Bary, Paul, Electrician, 5, Rue Gay-Lussac, Paris

Basse & Selve, Telegraph, Telephone and Electric Light Wire Makers, Altena, Westphalia (*Selve Altena Westfalen*)

Bassée & Michel, Electrical Apparatus Makers, 92, Rue de Bondy, Paris

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Baudot, Emile, Inspecting Engineer of Telegraphs, 6, Rue Mayet, Paris

Baudry & Co, Publishers of Electrical & Scientific Books, 15, Rue des Saints Pères, Paris

Bauer & Betz—*see* Berliner Elektrotechnische Fabrik

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Bauerlein (J.) & Kummler, Electrical Apparatus Makers, Aarau, Aargau, Switzerland

Baumbach, P., Electrical Engineer, 19, Rheinstrasse, Darmstadt

Baume, —, Telegraph Inspector, Direction Générale des Postes et des Télégraphes, Besançon (Doubs), France

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Baussart, Capt. —, Electrician and Professor at the Ecole Militaire, Brussels

Bayet, Maurice, Electrical Engineer to the Société Electricité et Hydraulique, 17, Rue Hemricourt, Liége

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Bechtold, F., Inspector and Telegraph Superintendent of the Nordouestbahn, and Secretary, Elektrotechnischer Verein, 7, Nibelungengasse, Vienna

Becker & Schöppe, Electrical Apparatus Makers, 22, Gr. Brüdergasse, Dresden

Becker, Hugo, Electrical Apparatus Maker, 3, Kleiststrasse, Berlin, W.

Becker, Th., Consulting Electrical Engineer and Electric Light Contractor, 84, Gitschinerstrasse, Berlin, O.

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Beermann, G. & H., Electrical Apparatus Makers, v. d. Schlesischen Thor, Berlin, S.O.

Begas (Paul) & Co, Electric Light & Power Engineers and Contractors, 17, Grosse Eschenheimerstrasse, Frankfort-on-the-Main

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Beiblätter zu Wiedemann's Annalen der Physik und Chemie. (Publishers, G. and E. Wiedemann.) 12 parts, 20 marks per annum. Leipzig, Germany

Beisgen, Albert, Electrical Apparatus Maker, 46, Taubenstrasse, Berlin, W.

Belgian Royal Commission for Applications of Electricity to Mines, Brussels

Bell Telephone Company of Sweden, Telegraph, Telephone and Lightning Conductor Manufacturers, Stockholm

Bell Telephone Manufacturing Company (soc. anon.) Manufacturers of Telephones and Telephonic Apparatus, 33, Rue Boudewyns, Antwerp. (*Microphone Antwerp, 751*)

Bellens, Charles, Electrical Engineer, 111, Boulevard Magenta, Paris

Belleville (J.) & Co, Makers of the Belleville Engines for Electric Lighting, St. Denis (Seine), France

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Bélugou, V., Telegraph Engineer, 103, Rue de Grenelle, Paris

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Bender, E. & Co, Electricians and Manufacturers of Insulating Materials, 85, Boulevard Hainaut, Brussels

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Bendix, J., Telegraph Apparatus Maker, 31, Pallisadenstrasse, Berlin, N.O.

Bendix (Ferdinand) Söhne, Electrical Apparatus Makers, Landsberg a. d. Warthe, Germany

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Bulletin de la Société Internationale des Électriciens (monthly), 44, Rue de Rennes, Paris

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Christiania Elektricitetsverk, Manufacturers of Electrical Apparatus, Christiania

Christofle & Co, Electro-Metallurgists, 56, Rue de Bondy, Paris

Chronique Industrielle, 15, Rue des Halles, Paris. (Price 25fr. per annum)

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Compagnie Centrale d'Electricité (soc. anon.), Electric Light Engineers and Contractors, 14, Rue des Archers, Lyons

Compagnie Continentale Edison, Electric Light Engineers and Contractors, 28, Rue de Chateaudun, Paris. (*Edison Paris*)

Compagnie Continentale d'Electricité (société anonyme), 17, Rue de France, Brussels (J. Goffin, Chief Engineer). (*Electricité Brussels, 1504*)

Compagnie anonyme Continentale pour la Fabrication des Compteurs à Gaz et autres Appareils (J. Brunt & Co), Makers of the Brillie Electric Meter, 9-15, Rue Pétrelle, Paris. (*Compteurs Brunt Paris*)

Compagnie d'Eclairage Electrique du Secteur des Champs-Elysées (Mildé & Cie.) 52, Rue du Faubourg St. Honoré, Paris. Central Stations: Quai Michelet and 106, Rue de Villiers

Compagnie Electrique du Sectaur de la Rive gaucha, 1, Rue Novelle, Paris

Compagnie Electrique le la Loire, Electrical Engineers and Contractors, St. Etienne, France

Compagnie Electrochimique, de St. Béron, Electro-Chemists, 189, Boulevard St. Germain, Paris

Compagnie Electro-Mécanique (soc. anon.), Electrical Engineers and Contractors, 11, Avenue Trudaine, Paris. (*Electranic Paris*)

Compagnie Electrothermique, Electric Light, Heat and Power Engineers, 50, Rue de la Chaussée d'Antin, Paris

Compagnie pour la Fabrication des Compteurs et Materiel d'Usines (soc. anon.), Makers of the Elihu Thomson Electric Meter, 16 and 18, Boulevard de Vaugirard, and 31, Rue Claude-Vellefaux, Paris

Compagnie des Fonderies et Forges de l'Horme, Engineers and Electrical Apparatus Makers, 8, Rue Victor-Hugo, Lyon; and L'Horme, near St. Chamond (Loire), France

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Compagnie Française du Bi-Metal, **Makers of** the Martin Bi-Metallic Wire, 9, Rue Dieu, Paris. (MM. Dombrowski and Ducamp, Managers)

Compagnie Française de Charbons pour l'Electricité, Carbon Makers, 53, Rue de Chateaudun, Paris. Works: Nanterre (Seine). (*Charbelec Paris*)

Compagnie Française pour l'Exploitation des Procédés Thomson-Houston, Electrical Engineers, 27, Rue la Londres, Paris (*Elden Paris*)

COMPAGNIE FRANÇAISE DU TÉLÉGRAPHE DE PARIS À NEW YORK, 53bis, Rue de Chateaudun, Paris; Hôtel des Postes, Brest; and 40, Rue du Chilou, Havre. (*Telepany Paris; Telepany Brest*)

M. Lefaivre .. .. President
M. Pestel .. .. .. Man. Director
M. Harault de Ligny .. Secretary
(*See also* BRITISH DIVISION *and* UNITED STATES SECTION)

Compagnie Générale d'Entretien des Lampes Electriques, Repairers of Electric Lamps, 11, Rue d'Enghein, Paris

Compagnie Générale de Travaux d'Eclairage et de Force (ancienne maison Clémançon), Electric Light and Power Engineers, 23, Rue Lamartine, Paris. Works: Impasse Fénélon, Rue Milton

Compagnie Générale des Lampes Incandescentes (soc. anon.), Makers of Edison and Swan Incandescent Lamps, 1, Rue Lepelletier, Paris; and Rue de l'Orme, Ivry-sur-Seine, France; and at Antwerp (*Edison Paris*)

Compagnie du Home Téléphone, 9, Avenue de l'Opéra, Paris

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Compagnie Internationale d'Electricité, Makers of the Pieper System of Arc and Incandescent Lighting, 18, Rue des Bayards, Liége; 46, Rue du Pont Neuf, Brussels; and 122 and 124, Rue Lafayette, Paris. (*Electron Liége, 529; Legia Paris*)

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Compagnie Liegeoise du Téléphone Bell (société anonyme), Liége, Belgium

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Compagnie Parisienne d'Installations Centrales de Chauffage et d'Electricité—*now* Compagnie Electrothermique (*q. v.*)

Compagnie de Télégraphie et de Telephonie Internationales (soc. anon.) (anciens ateliers Mourlon), 43, Rue de la Poste, Brussels—*in liquidation.*

Compagnie du Théâtrophone (Société anonyme d'auditions téléphoniques), 23, Rue Louis-le-Grand, Paris

Compania Aragonesa de Electricidad, Electric Light Engineers, Saragossa, Spain

Compañia General de Electricidad, Agents for Siemens & Halske, 36, Carrera de San Jerónimo, Madrid

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Constantia Incandescent Lamp Manufactory, Makers of the "Constantia" Incandescent Lamp, Venloo, Holland

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Cuénod, Sautter & Co—see Compagnie de l'Industrie Electrique Genève

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Dingler's Polytechnisches Journal (weekly), published at the Cottalsche Buchhandlung, Stuttgart (9 Marks a quarter)

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Dujardin & Cie, Makers of High-speed Steam Engines, Lille (Nord), France

Dujardin (P. J. R.) & Co, Makers of the Dujardin Accumulator, 28, Rue Vavin, Paris. Works: Pont Authon (Eure)

Dujardin, G., Electro-Chemical Engraver (Metal and Celluloid), 84, Rue Brûle-Maison, Lille, France. (Letters and telegrams: *Gravure Dujardin Lille*).

Dulait, J., Managing Director of the Société d'Electricité et Hydraulique, 40, Rue Montigny, Charleroi, Belgium

Dumont, G., Electrical Engineer, 110, Rue du Faubourg Poissonnière, Paris

Dumont, Joseph, Telegraph Engineer, 25, Rue des Plantes, and Nord Station, Brussels

Duplessy & Hinque, Wire Drawers, &c., 220, Rue St. Martin, Paris

Dupont, —, Electrician, 66, Boulevard de la Senne, Brussels

Dupuich, —, Electrical and Civil Engineer, 70, Avenue de la Toison d'Or, Brussels

Durr, Robert, Electrical Agent, 147, Rue Masin, Brussels

Dussart, Charles, Electrician, Administration des Télégraphes, Ghent

Dusseldorfer Elektromotorenfabrik, Bünger & Co, Dynamo and Motor Makers, Dusseldorf

Duvillard, —, Turbine Maker, Au Vallon, Lausanne, Switzerland

*Dvorák, Dr. V., Consulting Electrician and Professor at the Royal University, Agram, Austria

Du Weltz, —, Electrical Engineer, Rue du Châlet, Brussels

— E —

Ebel, G., Electrical Engineer, Manager of the Central Station, Secteur des Champs Elysées, 51, Rue du Faubourg St. Honoré, Paris

Eberhardt & Jäger, Electric Lamp Makers, Ilmenau, Thuringia, Germany

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Ebert & Co, Electrical Engineers and Contractors, 29, Grenadierstrasse, Berlin, C.

Ebert, Dr. Hermann, Physicist, University, Erlangen, Germany

Eckelt, J. L. C., Electrical Engineer, 166, Müllerstrasse, Berlin, N.

Ecker, W., Dealer in Electrical Apparatus, 9, Kappelplatz, Lucerne, Switzerland

Eckinger, Friedrich, Electrical Engineer, Baste, Switzerland

Eclairage Electrique, L' (soc. anon.), Electrical Engineers, 15, Place Vendôme, and 250, Rue Lecourbe, Paris. (*Léclique Paris*)

École Municipale de Physique et de Chimie Industrielles, 42, Rue Lhomond, Paris.
— Schutzenberger ... ... Director
E. Hospitalier ... ... (Professor of Electricity
Paul Gasnier ... ... Chief Assistant

Ecole Nationale d'Electricité et Horlogerie, Brussels. (M. de Fontaine, Professor of Electricity)

Edel, E., Electric Light Engineer, 116, Dresdenerstrasse, Berlin, S.

Edelmann, Dr. M. Th., Electro-Magnetic Apparatus Maker, 82, Nymphenburgerstrasse, Munich, Bavaria

Eenberg, B. Reimers, Manufacturer of Electrical Machinery, 39, Rue Henri Maus, Brussels. (*Eenberg Brussels.*) (*See also* Goolden, Atkinson & Bigge)

Eggebrecht & Grüne, Telegraph Apparatus Makers, 64, Lothringerstrasse, Berlin, N.

Egger (B.) & Co, Incandescent Lamp Manufacturers and Electrical Engineers, 187, Simmeringerstrasse, Vienna, X.; and 7, Huszargasse, Budapest, VII.

Eggersmann & Lang, Electric Light Engineers and Contractors, 8a, Pontdrisch, Aachen, Germany

***Eggington, A.**, Eastern Telegraph Company, 28, Via Venti Settembre, Rome. (*Eggington Rome*)

Ehemann (Gottfr.) & Co, Telephone Apparatus Makers, 31 and 33, Obere Pirkheimerstrasse, Nuremberg

Ehrling, Otto, Electric Light Engineer and Contractor, 73, Karl Heinestrasse, Leipzig Plagwitz

Einstein (J.) & Co, Electric Light Engineers and Contractors, 14, Adlzreitstrasse, Munich

Electra Aktien-Gesellschaft, Electrical Engineers and Contractors, Amsterdam

Electrical and General Engineering Syndicate, Loveday-st, Johannesburg

Electric Copper Refining Company, Osaka, Japan. (Takebumi Ishikawa process)

Electricien, L'), *Revue Internationale de l'Electricité et de ses Applications* (weekly), 3, Rue Racine, Paris. (Ann. sub., 25 fr. = £1)

Elektricitat, Die (semi-monthly), Leipzig. (Ann. sub, 8 mark)

Electricitats Aktien-Gesellschaft vormals W. Lahmeyer & Co, Electrical Engineers, Frankfort-on-the-Main, Germany (*Kraftlicht Frankfurt a/M*)

Elektricitäts-Gesellschaft, Electrical Engineers and Contractors, Admiralitatshof, Hamburg. (M. H. Hartogh, Manager.) (*Gea Hamburg, 44*)

Electricitäts-Gesellschaft Gelnhausen, Electrical Engineers and Contractors, Altenhasslau bei Gelnhausen, Germany. (Prof. Dr. R. Weber, Manager)

Electricista, El (monthly), Pelayo 10, Barcelona, Spain. (*Noble Barcelona, 725*)

Électricité (weekly), 31, Boulevard des Italiens, Paris. (Annual subscription, 15fr.)

Électricité et Hydraulique (soc. anon.), Electrical Engineers, Charleroi, Belgium; and 39, Rue de Chateaudun, Paris. (J. Dulait, Managing Director.) (*Electricité Charleroi.*) (*See also* BRITISH DIVISION)

Electriciteits Maatschappij—*see* Electricitäts-Gesellschaft Gelnhausen

Electricity Supply Company for Spain, Limited, La Goya, 13, Madrid, Spain. (*See also* BRITISH DIVISION)
H. E. C. Clarke .. .. Manager
—. Chisholm .. .. .. Chief Engineer

Electrique, (L') (société anon.), 279, Chaussée d'Anvers, Brussels. Central Lighting Station, 15, Rue Zérézo. (J. Julien, Manager). (*Electrique Brussels.*)

Electrogénique, L' (soc. anon.), Electrical Apparatus Makers, 7, Rue Godot-de-Maury, Paris. (M. Bounin, Manager)

Electrolyse (L') (soc. anon.), Electricians and Electrical Engineers, 27, Rue du Faubourg. Poissonnière, Paris

ELEKTRISCHE GLÜHLAMPENFABRIK "WATT" Makers of Incandescent Lamps, 87, Grinzingerstrasse, Nussdorf, Vienna. (Rudolf Latzko, General Manager. (*Watt Vienna, 4924*) **See Advts., pp. 39 and 573**

Elektrisk Bureau, Electrical Engineers and Agents, 4, Boldhusgade, Copenhagen, Denmark. (*Svendsen Copenhagen, 191*)

Elektrisk Bureau, Electrical Engineers and Contractors, 3, Dokvelen, Christiania. (B. Kolbenstoedt, General Manager) (*Elektriken Christiania*)

Electrizitäts Aktien - Gesellschaft vormals Schuckert & Co, Electrical Engineers, Nuremberg. (*Schuckert Nuremburg*)

Elektrochemische Gravir - Anstalt, Electro-Chemical Engravers, 1, Gertraudtenstrasse, Berlin, C. (*I. 719*)

Elektrochemische Werke, Electro Chemists, 22, Schiffbauerdamm, Berlin. N. (Manager, Dr. W. Rathenau)

Electro-Mekaniska Aktiebolaget Norden, Electrical Engineers, Stockholm

Elektron Lighting Company, Limited, Gothenburg, Sweden. (James G. Calvert, Managing Director)

Elektrotechnical Institute, 10, Berggasse, Vienna IX.

Elektrotechniker, Der (semi-monthly), 23, Victorgasse, Vienna, IV. (*3080.*) (Ann. sub., M.12 = 12s.)

Elektrotechnische Bibliographie (monthly, 6, Johannisgasse, Leipzig. (Dr. Georg Maass, Compiler). (Annual subscription, 5 Marks)

Elektrotechnische Gesellschaft, 5, Gotheplatz, Frankfort-on-the-Main

Elektrotechnische Gesellschaft zu Cöln, Cologne, Germany (Herr Stubben, President; Herr Ross, Secretary)

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Elektrotechnische Gesellschaft zu Leipzig, 1, Brüderstrasse, Leipzig. (R. Donath, President; Dr. Georg Maass, Secretary)

Elektrotechnische Industrie-Gesellschaft Langhans & Co, Incandescent Lamp Makers, 13, Schillingstrasse, Berlin, O.

Elektrotechnische Lehr- und Untersuchungs-Anstalt des Physikalischen Vereins zu Frankfort-on-the-Main, Germany. (Instructors in Electricity: Herren Dr. J. Epstein, Dr. Oscar May, E. Hartmann, Massenbach, Dr. Nippoldt, and Schmidt)

Elektrotechnische Versuchsstation zu Magdeburg, 21 and 22, Westendstrasse, Magdeburg. (Dr. Martin Krieg, Director)

Elektrotechnische Versuchsstation, 12, Heinestrasse, Berlin, S.W.

Elektrotechnische Versuchsstation, Munich. (Dr. C. L. Weber, Director)

ELEKTROTECHNISCHE ZEITSCHRIFT (*Centralblatt für Elektrotechnik*) (weekly), 3, Monbijouplatz, Berlin, N. Edited by F. Uppenborn; published in Berlin by Julius Springer, and in Munich by R. Oldenbourg. (Price 25s. per ann.)

This journal can be ordered through "THE ELECTRICIAN" PRINTING AND PUBLISHING COMPANY, LIMITED, *1, 2 and 3, Salisbury-ct, Fleet-street, London, England*

Elektrotechnischer Anzeiger (twice weekly), 6, Lutzowstrasse, Berlin, W. (Price 10s. per annum)

Elektrotechnischer Verein, Hôtel "Magdeburger Hof," Magdeburg

Elektrotechnisches Echo (weekly), 5, Königsstrasse, Leipzig. (Dr. Martin Krieg, Director; Oskar Leiner, Leipzig, Publisher. (Price 3M. = 3s. per quarter)

Elektrotechnischer Rundschau (fortnightly), 10, Kaiserstrasse, Frankfort-on-the-Main. (Chief Editor, Prof. Dr. G. Krebs.) (Half-yearly subscription, 6 Marks = 6s.)

Elektrotechnischer Verein, 7, Nibelungengasse, Vienna I. (Ottomar Volkmer, President; Fried. Bechtold, Secretary)

ELEKTROTECHNISCHER VEREIN, 40, Artilleriestrasse, Berlin. (*For principal Officials, see p. 686*)

Elektrotechnisches Institut der k. k. techn. Hochschule, 12, Paniglgasse, Vienna IV. (Dr. Adalbert von Waltenhofen, Director)

Elektrotechnisches Institut, 113, Leipzigerstrasse, Berlin, W. (Albert Friedländer, Electrical Engineer)

Elektrotechnisches Institut der königl.-technischen Hochschule, Stuttgart, Würtemburg, Germany (Prof. Dr. Wilh. Dietrich, Prof. of Electricity)

Elettricista, L' (monthly), 193, Via Panisperna, Rome. (Ann. sub., 12s.)

Elettricità, L' (weekly), 2, Via Meravigli, Milan. (Price 15fr. per annum)

Elmore's Metall-Aktiengesellschaft, Makers of Copper Seamless Tubes, Cologne

Elsässische Electricitäts-Werke (Otto Schulze), Electrical Engineers, 10a, Regenbogengasse, Strasburg, Elsass, Germany

Elwell, T., Electrical Engineer, 223, Avenue de Paris, Plaine St. Dénis (Seine), Paris

Emmerling, W., Maker of Insulating Materials, Nuremberg

Endruweit (C.) & Co, Electrical Engineers, 21, Lindowerstrasse, Berlin, N.

Energie Electrique (L'), Electrical Engineers, 99, Rue Richelieu, Paris

Engel & Heegewaldt—*see* Frister, R.

Engelfred, Arthur, Electrical Engineer and Patent Agent, 8, Rue St. Quentin, Paris

Enterprise de Tramways et Chemins de fer Electriques, 5, Rue Colbert, Marseilles. (*Railway Marseilles*)

Epstein, Dr. J., Electrical Engineer and Manager of the Elektrotechnischer Lehr- und Untersuchungs Anstalt des Physikalischen Vereins, Frankfort-on-the-Main

Ercoreca, Rufino, Electrician, c/o Armando Legorgen, Constructor Mecánico, Bilbao, Spain

Erdmann, Dr. E. O., Electrician, 7, Schellingstrasse, Berlin, S.W.

Erfurter elektrotechnische Anstalt, R. Dietz, Electrical Apparatus Makers, 21, Waldengasse, Erfurt

Erfurth & Sinell, Electrical Agents, 7, Neuenbergerstrasse, Berlin, S.W.

Erhard, Th., Manager of the Central Station, Altona a. Elbe

Erich, O. H., Electric Light and Power Engineer, 6, Büschstrasse, Hamburg

Ericsson (L. M.) & Co, Makers of Telegraph, Telephone and General Electrical Apparatus, 5, Tulegatan, Stockholm, Sweden. (*Mikrofon Stockholm*)

Eriksson's (J. E.) Mek. Verkstad, Electrical Apparatus Makers, Stockholm

Ernecke, Ferd., Manufacturer of Electrical Instruments, 112, Königgrätzerstrasse, Berlin, S.W., 46

Erste Ungarische Elektricitäts-Gesellschaft, Electrical Engineers and Contractors, Vienna. (Dr. A. Matlekovits, President)

Eschbaecher, —, Telegraph Engineer, Secretary of the International Telegraph Bureau, Berne, Switzerland

Escher, Wyss & Co—*see* Aktiengesellschaft Escher, Wyss & Co.

Establet, B., Superintendent, West African Telegraph Company, Gaboon

Estaunié, E., Telegraph Engineer, 40, Rue Vaneau, Paris

Établissements L. Liotard jeune, Electric Light Apparatus Makers, 22, Rue de Lorraine, Paris

European Sims-Edison Electrical Torpedo Company, Limited, Makers of the Sims-Edison Torpedo, 3, Rue Vignon, Paris (*Vitellius Paris*) (*See also* BRITISH DIVISON)

Evans, W. N., Manager in Egypt, Telephone Company of Egypt, Limited, Alexandria

Even, Victor, Electrical Engineer, 77, Rue de Brabant, Brussels

Evrard, F., Telegraph Engineer-in-Chief, Director of the Belgian State Telegraphs, Brussels

Exner, Prof., Electrician, 59, Währingerstrasse, Vienna, IX.

Expert (Ch.), Bezançon & Cie, Makers of the Faure-Sellon-Volckmar Accumulator, 187, Rue du Chateau-des-Rentiers, Paris

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— F —

Fabbrica di Accumulatori Elettrici, sistema Gottfr. Hagen (Giov. Hensemberger) Monza, Italy

Fabri, Ruggiero, Electrical Engineer, 314, Via Dante, Ravenna, Italy

Fabrica Central, Manufacturing Mechanical and Electrical Engineers, General Iron Works, No. 480, Rua 24 de Julho, Lisbon. (*Central Lisbon, 479*)

Fabrik elektrischer Beleuchtungskohlen Nürnberg, A.-G. (formerly Ch. Schmelzer), Arc Light Carbon Makers, Nuremberg, Germany. (*Schmelzer Nuremberg, 267*)

Fabrik Elektrischer Uhren und Apparate Actien-Gesellschaft (vormals C. Bohmeyer), Electric Clock and Apparatus Makers, Halle a. S., Germany.

Fabrique de Télégraphes et Appareils Electriques (Peyer, Favarger & Cie), Neuchâtel, Switzerland

Faesch & Piccard, Turbine Makers, 1, Rue de Malagnon, Geneva

Fagard, Pierre, Electric Light Engineer, 15, Quai d'Amercœur, Liège, Belgium

Fäller, Wilh., Electric Light Contractor, 6, Aarstaden, Strasburg, Germany

Fallgatter, E., Electrical Engineer, 15, Albertstrasse, Leipzig

Fallou, J., Electrical Engineer, 68bis, Avenue de Chatillon, Paris

Fargues, John, Assistant Superintendent, Indo-European Telegraph Company, Teheran, Persia

Farman, Dick, Electrical Engineer, 72, Boulevard Haussmann, Paris

Fastenakel, L., Secretary of Electrical Companies, 16, Rue Maes, Brussels

*Faure, C. A., Electrician, 37, Avenue de la République, Paris

Faure, Pierre, Electrical Engineer, Place du Champ-de Foire, Limoges (Haute-Vienne), France

Faye, A. H., Electrician, 95, Avenue de Champs-Elysées, Paris

Federmann, P., Electric Light Apparatus Maker, 15, Tempelhofer-Ufer, Berlin, S.W.

Fehr, Konrad, Director-General of Swiss Telegraphs, Berne, Switzerland

Fein, C. & E., Engineers and Makers of Electric Light and all kinds of Electrical Apparatus, Telegraphenbau-Anstalt, Stuttgart, Germany. (*Fein Electriker Stuttgart*)

Feldmann, Clarence P., Engineer to the Municipal Electric Works, 30, Rosenstrasse, and 1, Metzerstrasse, Cöln, Germany

Felix, C., Electrical Engineer, Sucrerie de Sermaize, Marne, France

Feller, Josef, Maker of Electric Wires and Cables, 54, Kaiserstrasse, Vienna, VII.

FELTEN & GUILLEAUME, Wire Makers and Drawers, Carlswerk, Mülheim-on-Rhine, Germany. (W. F. Dennis & Co, 11, Billiter-st, London, E.C., England, Sole Agents.) (*Carlswerk Mülheim Rhine; Fredennis London, 4350.*) **See Advt., p. 9**

Feray & Cie, Turbine Makers, Essonnes (Seine), and 74, Rue Turbigo, Paris. (*Feray Essonnes*)

*Ferraris, Prof. Galileo, Electrician, Turin

Ferrié & Cie, Wire Makers, 11, Rue Rhumkorff, Paris

Ferrini, Prof. Rinaldo, Electrician, R. Instituto Tecnico Superiore, Milan

Ferro-Nickel, Le (soc. anon.), Makers of High-Resistance Electric Wires, &c., Lizy-sur-Ourcq (Seine-et-Marne), and Paris

Fetter, J., Maker of the Archat-Fetter Arc Lamp, 4, Rue du Texel, Paris

Feuerlein, Dr. O., Electrician, 39, Kurfürsten-Allee, Charlottenburg, Berlin

Feytens, P. F., Superintendent, Direct Spanish Telegraph Company, Hotel des Postes et Télégraphes, Rue St. Cannat, Marseilles, France

Figee & De Kruijff, Electrical Engineers, 28 and 30, Voorburgwal N.Z., Amsterdam. (*Figee Amsterdam*)

Finet, —, Electric Battery Maker, 60, Rue d'Angleterre, Brussels

Fischer, Dr. H., Director German Imperial Telegraph Service, 15, Leipzigerstrasse, Berlin, W.

Fischer, Fr., Electrical Engineer and Manufacturer of Electric Light Carbons, 18, Parkring I., Vienna

Fischinger, E., Electrical Engineer, Niedersedlitz bei Dresden, Saxony

Flaquer, Alfonso, Engineer, &c., Representative of Planas, Flaquer & Co, and Agent in Spain for the Babcock and Wilcox Boilers, 22, Ronda Universidad, and 10, Fontanella, Barcelona, Spain. (*Flaquer Barcelona, 128*)

Fleig, Karl, Telegraph and Telephone Apparatus Maker, Villingen, Baden, Germany

Fleischhacker & Möhrle, Makers of the Möhrle Incandescent Lamp, Munich, Pasing

Fleischhauer & Tholehrn, Electrical Agents, 1, Lützowstrasse, Hanover

Flohr, Carl, Maker of Electric Cranes and Lifts, 28b, Chausséestrasse, Berlin, N.

Flohr (F.) & Devaranne, Electrical Engineers, 12, Fährstrasse, Kiel, Germany

Fodor, Etienne de, Electrical Engineer and Manager of the Central Electric Station, 17, Rue de l'Université, Athens, Greece

Foerderreuther, Dr. A. D., Electrical Engineer, General Direktion der Staatseisenbahnen, Munich

Foerster, Christoph Gottlob, Manganese and Battery Carbon Merchant, Ilmenau, Thüringia; and 35, Prenzhauerstrasse, Berlin

Foerstering, H. O., Electrical Engineer, 12, Leipzigerstrasse, Berlin, W.

Fonderie et Tréfilerie de Bronze Phosphoreux d'Anderlecht, Makers of Phosphor Bronze Telephone and Telegraph Wire, &c., 415, Chaussée de Mons, Anderlecht-lez-Bruxelles. (J. Manne, Manager.) (*Manne Cureghem, 848.*)

Fonderies et Laminoirs de Biache-Saint-Vaast (soc. anon.), Metal Manufacturers, Makers of Electric Wires, 28, Rue St. Paul, Paris. Works: Biache-Saint Vaast (Pas-de Calais) and Ougrée (Belgium)

Fonseca, M., Consulting Electrician, 7, Rione Sirignano, Naples. (*Fonseca Naples*)

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Fontaine, G., Electrical Apparatus Maker, 18, Rue Monsieur-le-Prince, and 24, Rue Racine, Paris. (*Fongeorges Paris*)

Fontaine, Hippolyte, Manager Société de Machines Magneto-Electriques de Gramme, 52, Rue St. Georges, Paris

Fontaine, M. de, Professor of Electricity, École Nationale d'Electricité et Horlogerie, Brussels

Föppl, August, Ph.D., Electrician, 7, Schenkendorfstrasse, Leipzig, III.

Forster, W. G., Superintendent, Eastern Telegraph Company, Zante

Fortin, Hallais & Cie (Société departementale d'Electricite), Electrical Engineers and Contractors, 16*bis*, Rue des Ursines, Vire (Calvados), France

Fortin, l'Abbé, Electrician, Chalette (Loiret), France

Fortin-Herrmann, A., Electrical Engineer, 81, Boulevard Brune, Paris

Fortschritte der Elektrotechnik (quarterly), edited by Dr. Karl Strecker, 51, Bülowstrasse, Berlin, W., and published by Julius Springer, 3, Monbijouplatz, Berlin, N.

Foucher père, Electrical Engineer, 2, Traverse du Chapitre, Marseilles, France

Fouquemberg, Nestor, Electrical Engineer, Vasmes, near Mons, Belgium

Foureault, Alfred, Electrical Engineer to the Société Lyonnaise de Mécanique et de l'Electricité, 101, Avenue de La Bourdonnais, Paris

Fournier, Raymond Georges, Electrician and Electrical Engineer, 6, Rue Hélène, Paris

Fraas Gebrüder, Dynamo Makers, Wunsiedel i. Bayern, Germany

Frager, —, Manager of the Compagnie pour la Fabrication des Compteurs et Matériels d'Usines, 23, Boulevard de Strasbourg, Paris

Française, La (Compagnie d'Electricité), Manufacturers of Incandescent Lamps, 17, Rue Le Peletier, and 31, Rue Claude-Bernard, Paris. (MM. Robin and Grival, Managers)

Franck & Co, Makers of Dynamo Brushes, Schlettstadt i. E., Germany

François (L.), Grelon (A.) et Cie, Makers of Electric Wires and Cables, 43, Rue des Entrepreneurs, and 20, Rue Notre Dame de Nazareth, Paris

Franken, G. L. H., Electric Light Contractor, 48, Kaiser Wilhelmstrasse, Berlin, C.

Frankfurter Accumulatoren-Werke (C. Pollak & Co, Kommandit-Gesellschaft), 147, Hanauer Landstrasse, Frankfort-on-the-Main (*Acco Frankfortmain, 1748*)

Frankfürter Telegraphendraht und Kabelfabrik (Emil Blust), Makers of Electric Wires and Cables, 129, Hainerweg, Frankfort-on-the Main. (*Blust Frankfortmain, 258*)

Franklin Gesellschaft für elektrische Anlagen, Electrical Engineers, Vienna

Frankl, L., Electric Light and Power Engineer, 12, C1, Mannheim, Baden

Fredriksstad Telephone Company, Fredriksstad, Norway. (Olaf. M. Holwech, Manager)

Frédureau & Cie, Makers of the Frédureau Ray Diffuser, 52, Rue Lafayette, Paris

Fremmery (Dr. M.) & Co—*see* Rheinische Glühlampen-Fabrik

Frémy, E., Manufacturing Electrical Engineer, 89, Boulevard Anspach, Brussels

Frenay, Henri, Electrical Engineer to the Administration des Télégraphes, 64, Rue Dailly, Brussels

Freund, Siegfried, Electrical Engineer, Attorney of the Hungarian Incandescence Lamp Manufacturing Company, 34c, Arena-út., VII., Budapest

Freyeisen & Schröder, Makers of Electric Light Apparatus, 21, Siemensstrasse, Sachsenhausen, Frankfort-on-the-Main

Fribourg, G., Inspector-General of Posts and Telegraphs, 132, Boulevard Saint-Germain, Paris

Friedlaender (Albert) & Co, Telephone Engineers, Makers of the Friedlaender Portable Lamp, 115 and 132, Liepzigerstrasse, Berlin, W. (*Friedlaender Elektrizität Berlin, 7403*)

Friedrich, A., Electric Light Engineer, 43, Prenzlauerstrass, Berlin, C.

Frison, Emile, fils, Manufacturing Electrical Engineer, Forges de Bologne (Haute-Marne), France

Frister, R., Maker of Electric Light Fittings, 23, Lindenstrasse, Berlin, S.W. (Engel & Heegewaldt, Proprietors)

Fritsche & Pischon, (Inhaber, W. Fritsche), Electricians and Electrical Engineers, Makers of the Radanker and Glockenanker Dynamos, 4, Am Kupfergraben, Berlin, N. (*Dynamo Berlin*)

Fritsche, W., Engineer and Electrician, 4 Am Kupfergraben, Berlin, N.

Fritz (C.) & Co, Electrical Engineers, 73, Bayerstrasse, Munich

Fröhlich, Dr. C., Electrician, Aschaffenburg, Germany

*Frölich, Dr. O., Electrician, 94, Markgrafenstrasse, Berlin

Fröhlich & Perthen, Electric Light and Power Engineers, 14a, Beatrixgasse, Vienna, III.

Frühinsfeld & Co, Electric Light and Power Engineers, 16, Woltmannstrasse, Hamburg

Fuchs (J. J.) & Sohn, Electrical Engineers, Bernburg-Saale, Germany

Fuchs, J. W., Maker of Electric Wires and Carbons, Nuremburg

Fujioka, Ichisuke, Dr. E., M.E., Lecturer in Electrical Engineering, Imperial University, Tokyo, and Engineer-in-Chief to the Tokyo Electric Light Company, Tokyo, Japan

Fulgur, Le (soc. anon.), owners of the Jeanty Electric Light Patents, 19, Rue Turgot, Paris. (*Fulgur Paris*)

Fussner, H., Electrical Apparatus Maker, 16, Heuwaagstrasse, Erlangen, Bavaria

— G —

Gabriel (F.) & Angenault (H.), Makers of the Gabriel Incandescent Lamp, and Sole Agents in France of the Vitrite Patents, Combs-la-Ville (Seine-et-Marne), and 24, Boulevard Poissonnière, Paris

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Gachet, Olivier, Electrical Engineer, Maker of the Brianne Arc Lamp, 22, Rue des Martyrs, Paris

Gadot (Paul) & Pisca (Michel), Electrical Engineers and Makers of Accumulators, 89, Rue de Tocqueville, Paris. (*Paul Gadot Paris*)

Gaebler, O., Electrician, Messrs. Hartmann & Braun, Bockenheim, Frankfort-on-the-Main

Gaiffe, G., fils, Electrical Apparatus Maker, 9, Rue Méchain, and 40, Rue Saint-André-des-Arts, Paris

Gaillet, Paul, Electrical Engineer and Contractor, 8, Rue Nicolas Leblanc, Lille (Nord), France. Works: La Madeleine-lez Lille (*Gaillet Lille*)

Gaisberg, S. Freiherr von, Electrical Engineer, Hamburg

Galé, J., Electrician, 8, Rue de Commerce, Geneva

Gallais, A., Electrical Apparatus Maker, 73, Boulevard de la Villette, Paris

Gallais, D., Electrical Apparatus Maker, 11, Rue de Crussol, Paris

Galle, Richard, Maker of Galvanic Batteries and Electro-Medical Apparatus, 8, Alte Jakobstrasse, Berlin, S.W.

Galliot, —, Electrical Engineer, Ingénieur des Ponts et Chausses, Dijon, France

Gally, Daloz & Viette, Electrical Engineers, 64, Rue Tiquetonne, Paris

Galotte, E., Electrician, 174, Rue de Crimée, Paris

Galvanophorenwerke (Liman & Oberlaender), 20A, Karlstrasse, Berlin

Galy, H., Maker of Electric Light Fittings, 8 and 10, Rue Ternaux, Paris

Ganz & Co, Dynamo, Motor and Transformer Makers, Electric Lighting Engineers and Contractors, Budapest; Leobersdorf; and 31, Wasagasse, Vienna IX. (*Ganzcomp Budapest*)

Garbe, Lahmeyer & Co—*see* Deutsche Elektrizitäts Werke zu Aachen

Gariel, C. M., Electrician, Professor at the Faculté de Médecine, 39, Rue Jouffroy Paris. (Secretary of the Association Française pour l'Avancement des Sciences)

Garnier, Paul, Manufacturer of Electrical Apparatus, 16, Rue Taitbout, Paris

Garnot, X., M.E., Electric Light Engineer and Contractor, 55, Rue de Chateaudun, Paris

Garrett, Smith & Co, Makers of Steam Engines for Electric Lighting, Magdeburg-Buckau, Germany

Garrone, Lorenzo, Electrical Engineer, 6, Corso Duca di Genova, Turin, Italy. (*Garrone Ingegnere Torino*)

Gasmotoren-Fabrik Deutz, Makers of the "Otto" Gas and Petroleum Engines, Deutz, near Cologne

Gasnier, Paul, Chef des Travaux Pratiques d'Électricité à l'Ecole Municipale de Physique et de Chimie Industrielles, 9, Rue Rouget de l'Isle, Courbevoie, France

Gatliff, P., Secretary to the Agency of the Anglo-American Telegraph Company and the Eastern Telegraph Company, 12, Rue Caumartin, Paris. (*Anglorient Paris*)

Gaulne, — de, Electrical Engineer, Rue Vital-Carles, Bordeaux (Gironde), France

Gaupillat, Marcel, Electrical Engineer, 13, Place des Vosges, Paris

Gautard, P., Electrician, Usines de Creusot (Saône-et-Loire), France

Gauthier-Villars et Fils, Technical Publishers, 55, Quai des Grands Augustins, Paris

Gebhardt, Paul, Electrical Apparatus Maker, 85 and 53, Prinzenstrasse, Berlin, S

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India Rubber, Gutta Percha and Telegraph Works Company, Limited, Persan Beaumont (Seine-et Oise), and 97, Boulevard Sevastopol, Paris. (*See also* BRITISH DIVISION)

Industria é Invenciones (weekly), Calle de la Canuda, 13—3°, Barcelona, Spain. (Ann. sub., 30 pesetas = £1 4s.)

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Industrie (L'), (weekly), combining *L'Ingénieur-Conseil*, *L'Industrie Moderne* and *Industria*, 13, Rue Ducale, Brussels; and 112, Rue de Richelieu, Paris. (Jules Germaert, Editor-in-Chief.) (Ann. sub., P.U., 25fr. = £1.)

Industrie Électrique (L') (twice monthly). (Editor, E. Hospitalier, 6, Rue de Clichy; Publisher, A. Lahure, 9, Rue de Fleurus, Paris; Secretary, M. Le Carpentier. (Ann. sub., P.U., £1.)

Industrie Génévoise d'Électricité (Olivet & Cie), Electrical Engineers, 6 and 7, Chemin du Mail, Plainpalais, Geneva. (*Dynamo Geneva, 1854*)

Industriel du Nord et des Ardennes (semi-monthly), 25, Rue Nicolas-Leblanc, Lille (Nord); 72, Rue Vivienne, Paris; and 12, Place de Nevers, Charleville, Ardennes, France. (Ann. sub., P.U., fr.6.50)

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Intermédiaire Electrique, L'—*see* **Liepmann** (Louis) & Cie.

Intermédiaire des Mathématiciens (L') (monthly), 55, Quai des Grands Augustins, Paris. (Conducted by Dr. C. A. Laisant and Emile Lemoine.) (Ann. sub., 6 francs)

International Bell Telephone Company of New York, Limited, 13, Marché aux Linge, Antwerp. (*Bell Telephone Antwerp, 325*)

Internationale Druckluft und Elektrititäts-Gesellschaft (Popp System), Electric Light Contractors, Unter den Linden, Berlin, W.

Internationale Elektricitäts Gesellschaft, Electric Light Engineers and Contractors, 30, Wipplingerstrasse, Vienna, I. (*Intelectro Vienna*)

Internationaler Central-Anzeiger für die gesammte Elektrotechnik (semi-monthly). Published by Gebrüder Knauer, Frankfort-on-the-Main, Germany

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Jackson Hermanos, Electrical Engineers and Agents, 22², Calle Arenal, Madrid

Jacottet & Co, Makers of Electric Wires and Cables, 57, Hauptstrasse, Vienna, IX.; Semmering, and Budapest

Jacquet Frères, Makers of Accumulators and Dynamos, Vernon (Eure), France

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Jacquez, Ernest, Telegraph Engineer, 54, Avenue de Breteuil, Paris

Jacquin, C., Electrical Engineer, 5, Avenue du Maine, Paris

Jaeger and Fischer, Electrical Apparatus Makers, Ludenschied i. W., Germany

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Janin (Louis) & Co, Dynamo & Motor Makers, 86, Rue de la Charité, Geneva; and Place Perrache, Lyons

Janssen, Alfred, Electrical Engineer, Rue de la Province, Liége

Japy Frères et Cie, Makers of the Japy Arc Lamp, &c., Beaucourt (Haut-Rhin-Français); and 7, Rue du Chateau d'Eau, Paris

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Jeanty, V.—*see* Fulgur, Le (société anon.)

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Josse, H., Electrician, Patent Agent and Manager of the *Revue Industrielle*, 58bis, Rue de la Chaussée d'Antin, Paris

Journal des Applications Electriques et Electro-Chimiques, 72, Rue Louis-Blanc, Paris. Firmin Leclerc, Editor. (Ann. sub., P. U., 6fr.)

Journal de Physique theorique et appliquée (monthly), 11, Rue Rataud, Paris. (Ann. sub., 15fr.)

Journal Telegraphique (monthly), Berne, Switzerland. (Ann. sub., P. U., 5fr. = 4s.)

Journaux, J., Microphone and Telephone Maker, 56, Rue des Cévennes, Paris

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Kölner Akkumulatoren-Werke, Gottfried Hagen, Makers of the Hagen Accumulator, Kalk bei Köln, and Mechernich, Germany. (Dr. E. Sieg, Manager) (*Metallhagen Kalk, Köln*)

Kolkhorst, A. O., Electrician, c o Elektrizitäts Aktien Gesellschaft vormals. Schuckert & Co. Maxi-milianplatz, Munich

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Körting Gebrüder, Engineers, Gas Engine Makers, &c., Körtingsdorf, near Hanover; and at Berlin, Paris, &c. (*See also* BRITISH DIVISION)

Körting & Mathiesen, Electrical Engineers and Arc Lamp Makers, 1, Blumengasse, Leipzig

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Krause, Eugene, Electrical Engineer, Cöln-Ehrenfeld, Germany

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KREIDLER, A.—*see* Stuttgarter Telegraphendraht-Fabrik (A. Kreidler), *and* **Advt., p. 36**

Kremenezky, Mayer & Co, Electric Light and Power Engineers and Contractors (General Representatives in Austria of the Brush Electrical Engineering Company, Ltd., of London), 9, Soveringasse, Vienna IX., 2. (*Kremenezky Vienna*)

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KÜCKE (W.) & CO, Elberfeld, Germany. (*Kücke Elberfeld*) **See Advt., p. 541**

Makers of Engineers' Tools, Linemen's Tool Wallets and Boxes, Clamps for Steel and Bronze Wire, Tackle, Vices, Soldering Tools, Pliers, Screw Drivers, Climbing Shoes, Telegraph and Telephone Tools, Telegraph Pocket Knives, &c., &c.

Kugel & Berg, Wire Manufacturers, Werdohl.-Westf., Germany

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Kugelmann & Co, Electrical Engineers, 29, Ross-strasse, Berlin, C.

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Laboratoire de la Tour St. Jacques, Paris. (M. Avril, Prof. of Electric Lighting; M. Hoornaert, Prof. of Telegraphy)

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Lacombe & Co—*see* Carbone, Le

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Lahmeyer (W.) & Co (Kommanditgesellschaft) —*see* Elektricitäts Aktien-Gesellschaft vormals W. Lahmeyer & Co

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LECLANCHÉ & CIE, Makers of the Leclanché Battery, 158, Rue Cardinet, Paris. **See Advt., p. 17** (*See also* BRITISH DIVISION)

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Lofquist, Hjalmar, Electrical Engineer, Exporter and Importer of Electrical Appliances, 6, Teatergatan, Stockholm, Sweden. (*Contractor Stockholm*)
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New Shanghai Electric Company, Limited—*Business taken over by the Shanghai Municipal Council. See* Shanghai Electric Light Works

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Pollak & Co. K.G.—*see* Frankfurter Accumulatoren Werke

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Revista Minera, Metalurgica y de Ingenieria (four times a month), 3, Villalar, Madrid. (Roman Oriol, M.E., Editor) Ann. sub., £1. (*Romol Madrid*)

Revista Tecnologico Industrial (monthly organ of the Asociación de Ingenieros Industriales), 30, Rambla de San José, Barcelona. (Ann. sub., 12 pesetas=9s. 6d.)

Revue Générale des Sciences pures et appliquées (twice a month), 58, Rue St. André-des-Arts, Paris. (Ann. sub., P.U., 22 frs. = 17s. 6d.)

Revue Industrielle (weekly), 58bis, Rue de la Chaussée d'Antin, Paris. (Ann. sub., 30 francs)

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1. Arc Light Carbon Factory
2. Electrotechnical, Medical, and Photographic Factory
3. Polished Wood Casings Factory and Steam Saw Mills
4. Machine and Engraving Works

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Rothgiesser & Co—*see* Merkur Kommanditgesellschaft

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Sächsische Broncewaarenfabrik Aktien-Gesellschaft, Makers of Electric Light Fittings, Badergraben, Wurzen-i.-S. (*Broncefabrik Wurzen, A.*)

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Sächsische Serpentinstein Gesellschaft (Wieland & Co), Insulator Makers, Zöblitz, Saxony (*Serpentinfabrik Zoblitz, A.*)

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Schöller, U., Electrical Agent, 38, Vom Werthstrasse, Cologne
Schomburg (H.) & Söhne, Manufacturers of Porcelain for Electrical Purposes, 97, Alt-Mabit, Berlin, N.W.
Schoop, Dr. Paul, Electrician, Battery Expert and Inventor of the Schoop Gelatine Battery, Manager of the Oerlikon Branch of the Accumulatoren-Fabrik Aktiengesellschaft-i-Hagen, Zweigniederlassung Oerlikon bei Zürich
Schoppe, Oscar, Electrical and Telegraph Engineer, 3, Bayerischestrasse, Leipzig
Schorch (Max) & Co., Electric Light and Power Engineers, 8, Friedrich Wilhelmstrasse, Rheydt, Germany
Schrader, L., Electrical Engineer, 95, Möckernstrasse, Berlin, S.W.
Schreihage Gebrüder, Electric Light and Power Engineers, 40, Promenadenstrasse, Chemnitz, Saxony
Schubart, T., Electrical Apparatus Maker, 27, Rue Courte du Marais, Ghent, Belgium
Schuch & Wiegel, Telegraph Apparatus Makers, 147, Köpenickerstrasse, Berlin, S.O.
Schuchhardt, F., Manufacturer of Telegraph Apparatus, 9, Wassergasse, Berlin, S.O.
Schuckert & Co, Kommanditgesellschaft—*see* Elektricitäts Aktien-Gesellschaft vormals Schuckert & Co. Nürnberg
*Schuckert, S., Electrical Engineer, Nuremburg, Germany
Schultze, F. F. A., Maker of Shades and Reflectors, 47 & 48, Fehrbellinerstrasse, Berlin, N.
Schultze, G. A., Electrical Apparatus Maker, 128, Kopnickerstrasse, Berlin, S.O.
Schumann's Elektrizitätswerk, 7, Mittelstrasse, Leipzig
Schumann & Küchler, Electrical Engineers, 87, Magdeburgerstrasse, Erfurt, Germany
Schülke, Baurath, Manager of the Municipal Electric Light Station, Barmen, Germany
Schulteis, Robert, Electrical Engineer and Contractor, 116, Grünenstrasse, Bremen, Germany (*244*)
Schulz & Lange, Manufacturers of Electrical Apparatus, 13, Schwartzkopffstrasse, Berlin N. (*Welthandel Berlin*)
Schwabe & Jehle, Electrical Engineers, 32, Breitegasse, Frankfort-on-the-Main
Schwabe, Otto, Electrical Engineer, 5, Rosenthalerstrasse, Berlin, C.
Schwartzkopff, Richard, Maker of the Schwartzkopff-Ochwadt Primary Battery, 172A, Müllerstrasse, Berlin, N.
Schweizerische Akkumulatorenbau Aktien-Gesellschaft, Accumulator Makers (Systems Blanc, Huber, and Reynier), Marly bei Freiburg, Switzerland
Schweizerische Druckluft und Elektricitäts-Gesellschaft, Electrical Engineers, 15, Amthausgasse, Berne, Switzerland
Schweizerischer Electrotechnicker Verein, Neuchâtel, Switzerland. (Prof. A. Palaz, Lausanne, General Secretary)
Sciama, Gaston, Electrical Engineer, Manager of the Maison Bréguet (soc. anon.), 19, Rue Didot, Paris
Science Moderne, La (weekly), 56, Rue Jacob, Paris. (Didot & Cie, Publishers.) (Ann. sub., P.U., 14fr. = 11s. 6d.)
Sciences et Commerce (semi-monthly), 24, Boulevard Poissonnière, Paris. (*Mercator Paris.*) (Ann. sub., P.U., 15fr. = 12s.)
Scovell, George R., Superintendent, West African Telegraph Company, Limited, Principe, West Coast of Africa
Scuka (J.) & Co, Electrical Engineers, 12, Hohenstaufengasse, Vienna, I.
Sechehaye & Gardy, Manufacturers of Accumulators, 4, Quai de la Poste, and (Works) La Plaine, Geneva, Switzerland; and Seyssel, France. (*Accumulateurs La Plaine Geneva*)
Secrétan, E. P., Electro-Metallurgist, 19, Boulevard Beauséjour, Paris
See, E & P, Electrical Engineers, 50, Rue Nicholas Leblanc, Lille (Nord), France
Seidel, Carl, Electrical Engineer, 4, Lüneburgerstrasse, Berlin, N.
Seifert, J. P., Maker of Primary Batteries, 4, Wernerplatz, Freiberg, Saxony

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Seiler, C., fils, Electrical Apparatus Maker, 15, Rue St. Pierre, Lausanne, Switzerland
Seitz & Linhart, Telegraph Apparatus Makers, Aschaffenburg, Germany
Selby, James A., Electrical Engineer, Ensanche, Bilbao, Spain (*Selby Bilbao Spain*)
Seligmann-Lui, G. P., Telegraph Engineer, 6, Rue Daubigny, Paris
Selves, M. de, Director-General of French Posts and Telegraphs, Paris
Senator, Severin, Electrical Engineer and Contractor, 5A, Wilhelmstrasse, Berlin, S.W.
Serres, Prof. L., Consulting Electrician, 103, Rue de Rome, Paris
Serrin, H. G. C., Electrical Apparatus Maker, 13, Boulevard du Temple, Paris (*3086*)
Serrin, V., Electrical Engineer, Neuilly-en-Thell (Oise), France
Seubel, Philipp, Electrical Engineer, 21, Fennstrasse, Berlin, N.W.
Sève, G. (Representative of A. J. Gérard), Electric Clock and Apparatus Maker, 19 Rue Ortelius, Brussels
Shanghai Electric Light Station (now the property of the Municipal Council), Chapoo-road, Shanghai. (Charles Mayne, Manager of Electrical Department)
Shea, Austin, M.I.E.E., Chief Electrical Engineer, Royal Siamese Public Works Department, Bangkok, Siam
Shorton & Easton, Electric Light Engineers, 97, Grabschnerstrasse, Breslau, Germany
Siam Electric Light Company, Ltd., Bangkok, Siam
Siat, Ferdinand, Electrician, 15, Rue du Commerce, Paris
Siedle (S.) & Söhne, Telegraph and Telephone Engineers, Furtwangen, Baden, Germany
Siegfried, Th., Electrical Engineer, Lucerne, Switzerland
*Siemens, Carl, Manufacturer and Electrician, St. Petersburg
Siemens & Co. (Gebrüder), Charlottenburg (Electric Light Carbons, etc.)
Siemens & Halske, 94, Markgrafenstrasse, Berlin, S.W. Branch Works: Charlottenburg, Berlin; St. Petersburg, Vienna, and The Hague
*Siemens, Friedrich, Maker of Glass for Electrical Purposes 51, Wiedner Hauptnerstrasse, IV. Vienna
Siemens, Wilhelm von, Manufacturer and Electrician, Berlin
Siempelkamp (G.) & Co, Electrical Engineers, 47, Louisenstrasse, Crefeld, Germany
Sierra y Alonso, Ildefonso, Electrical Engineer and Contractor, 8², Calle de Echegaray, Madrid (*420*)
Silfverberg, J., Dealer in Electrical Supplies and Agent for Messrs. Kremenezky, Meyer, & Co, 12, Hauserp'ads, Copenhagen
Sinell, Emil, Electrical Agent, 32, Neuenbergerstrasse, Berlin, S.W.
Singrun frères, Makers of the Hercules Turbine, Epinal (Vosges), France. (*Singrun Epinal*)
Simmen, A., Electrician, 55, Rue Dombasl, Paris
Sir, R., Electrical Engineer, 17, Boulevard de Strasbourg, Toulouse (Haute-Garonne), France
Siry, Lizars & Co, Electric Light Apparatus Makers, 23, Viale Porta Lodivica, Milan; 29-33, Rue Claude Vellefaux, Paris; and at Barcelona, Brussels, Rome, Strasburg, &c.
Sittig, Carl, Electrician, 29, Lichterfelderstrasse, Berlin, S.W.
Slaby, Dr. A., Professor of Electricity, Technische Hochschule, 4, Sophienstrasse, Charlottenburg, Berlin
Sloan (Jules) & Co, Electric Light Engineers and Contractors, 3, Rue du Louvre, Paris
Smit (Willem) and Co, Manufacturing Electric Light Engineers, Slikkerveer, Holland. (*Smit Company Slikkerveer Holland*)
Smith, Benjamin, M.I.E.E., Manager in Egypt of the Eastern Telegraph Company, Alexandria
Smith, J. R., Superintendent, West African Telegraph Company, Loanda, W. Africa
Snijders, J. A., Professor of Electricity at the Polytechnic School of Delft, 65, Voorstraat, Delft, Holland
Sociedad Anglo Española de Electricidad, 10, Pelayo, Barcelona, Spain. (*Noble Barcelona, 725*)
Sociedad Cooperativa de Vehículos Macánicos, Makers of Electric Carriages, Orellana 7, Madrid
Società Anonima Cooperativa di Telefoni, Telephone Engineers and Contractors, 149, Via Nazionale, Rome
Società Ceramica Richard, Makers of Battery Jars, Insulators, &c., Via Manzoni 16, and Sant' Cristoforo, Milan
Società Elettrica Industriale Franco-Italiana, Electric Light Engineers and Contractors 2, Via Meravigli, and 5, Via Dante, Milan, Italy
Società Elettrica Industriale Milano, Electrical Agents, 2, Via Meravigli, Milan
Società Esercizio Bacini, Limited, Electrical and General Engineers, 18, Piazza Annunziata, Genoa
Società Generale Italiana di Elettricità (Sistema Edison), 12, Via A. Manzoni, Milan, Italy. (*Edison Milano*)
Società Italiana di Elettricità pel progresso degli studi e delle applicazioni, Milan. (Prof. Alessandro Volta, President)
Società Italiana di Elettricità (Sistema Cruto), Makers of the Cruto Incandescent Lamp, Turin
Società Meridionale di Telefoni e di Electricità, 24, Via Medina, Naples. (Cav. F. Gallotti, Manager)
Società Nazionale della Officine di Savigliano, Electrical Engineers and Contractors, Savigliano and Turin, Italy
Société Alsacienne de Constructions Mécaniques, Electrical and General Engineers, 7, Rue Drouot, Paris. Works: Mulhouse, Belfort, and Grafenstaden, Alsace. (*Mecalsac Paris*)
Société anonyme des Anciens Ateliers de Construction Van den Kerchove, Electrical Engineers, 189, Coupure, Ghent, Belgium. (*Ateliers Vandenkerchove Ghent*)
Société anonyme des Anciens Etablissements Cail, Electrical Engineers, 15, Quai de Grenelle, Paris; and at Denain, Douai, and St. Denis

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Société anonyme d'Appareillage et d'Éclairage Electriques, Makers of the Cance Arc Lamp, 9, Rue de Rocroy, and 207, Boulevard Voltaire, Paris

Société pour les Applications Industrielles d'Electricité—*see* Lombard, Gérin & Cie

Société anonyme des Applications de l'Electricité (ancienne établissement Jarriant), Electrical Engineers, 25, Rue Pierre-Charron, Paris (M. Rousseau, Manager)

Société des Ateliers de Construction de Bitschwiller, Electrical Engineers, Makers of the Bacri Telephone, &c., Bitschwiller-Thann (Haute-Alsace), France

Société anonyme des Brevets Étrangers de Méritens, Owners of the de Méritens Battery Patents in countries other than France, 11, Rue de Saussure, Paris

Société (anonyme) Belge pour l'Éclairage et Transmission electriques à Longue Distance, Electric Light Contractors, 56, Rue des Bouchers, Brussels. (W. Dierman, Electrical Engineer and Manager)

Société Belge d'Electriciens, Palais de la Bourse, Brussels

M. G. Montefiore-Levi ... Hon. President
M. J. Banneux ... ... President
Capt. E. Lagrange, M. Courtoy ... Secretaries

Société anonyme Belge pour la Fabrication de Lampes Electriques à Incandescence, Makers of the Volta Incandescent Lamp, 10, Rue Metzys, Schaerbeek-Bruxelles. (E. Lange, General Manager) (*Volta Brussels*)

Société Belge des Ingénieurs et des Industriels, Palais de la Bourse, Brussels. (M. Michelet, President; Ch. Legrand, Secretary)

Société du Cable Fortin-Herrmann, Electric Wire Manufacturers, 138, Boulevard du Montparnasse, Paris

Société Centrale d'Electricité (Pulsford, Triquet and Cie), Electrical Engineers and Contractors, 10, Rue de Normandie, Asnières; 10, Rue Taitbout, Paris: and at Argenteuil

Société Cockerill à Seraing, General and Mechanical Engineers, Seraing, near Liège, Belgium

Société anonyme pour la Construction de Lampes à Incandescence—*see* Aktien-Gesellschaft für Elektrische Gluhlampen

Société de Constructions Mécaniques et d'Appareils Electriques, Electrical Engineers, 11, Rue St. Florentin, Paris

Société de Construction des Piles et des Accumulateurs à Liquide Immobilisé, Makers of the Pile-Bloc, &c., 98, Rue d'Assas, Paris. (René Heurtey, Manager)

Société Decauville aîné, General Engineers, Makers of Electric Motors, 13, Boulevard Malesherbes, Paris. Works: Petit-Bourg (Seine-et-Oise), France; and Diano Marina, near Genoa, Italy

Société d'Eclairage Electrique d'Argenteuil par les Accumulateurs au Cadmium—*see* Commelin & Cie.

Société d'Eclairage Electrique de Bordeaux et du Midi, 5, Cours de l'Intendance and (Works) 26 and 28, Rue du Temple, Bordeaux. (M. Tricoche, Engineer)

Société anonyme d'Eclairage Electrique de l'Ilot Tolozan, Electrical Engineers and Contractors, 31 Rue du Puits-Gaillot, Lyons

Société anonyme d'Eclairage du Centre, 22, Rue des Palais, Brussels. (L. Somzée, Administrateur Délégué) (*Somzée Bruxelles 236*)

Société anonyme d'Eclairage et de Force par l'Electricité, 13, Rue Lafayette, Paris: and 19, Boulevard de la Seine, Asnières-sur-Seine, France

Société d'Eclairage Electrique du Secteur de la Place Clichy, 53, Rue des Dames, Paris. (A. Lalance, Administrateur délégué; —Journet, Manager)

Société (anonyme) d'Electricité, Electrical Engineers and Contractors, 39, Avenue Marceau Courbevoie (Seine), France.

Société anonyme d'Électricité Industrielle (A. de Méritens & Co), Electrical Engineers, 71, Rue de Saussure, Paris

Société d'Electricité (Souchier & Cie), Electric Light Engineers and Contractors, 4, Rue des Recollettes, Marseilles

Société Electrique de Vevey-Montreux, Electrical Engineers and Contractors, Vevey-Montreux, Switzerland. (M. Dupraz, Manager)

Société L'Electrique, Makers of the Julien Accumulators, 279, Chaussée d'Anvers, Brussels (*Sta*), and 23, Rue du Bac, Paris. (J. Julien, Manager)

Société Electro-Chimie, Acid Manufacturers, 4, Rue de Trévise, Paris. (M. Lauras, Manager.) Works: Vallorbes (Vaud), Switzerland: and St. Michel de Maurienne (Savoie), France. (Works Manager: M. Nourisson) (*Trochim Paris*)

Société Electro-Métallurgique Française, Manufacturers of Aluminium (Héroult-Kilian process), Froges and Champ (Isères), France. (*Electrmetal Froges*)

Société Électrotechnique de Paris, 44, Rue de Rennes, Paris

Société Electrotechnique de St. Pétersbourg (W. Rebikoff, 24, Miliionnaia, St. Petersburg, President)

Société d'Encouragement pour l'Industrie Nationale, 44, Rue de Rennes, Paris. (MM. Collignon and Aimé Gérard, Secretaries)

Société d'Études practiques sur l'Electricité industrielle, Bourse du Commerce, Paris. (J. P. Anney, Secretary)

SOCIÉTÉ D'EXPLOITATION DES CABLES ELECTRIQUES (Système Berthoud-Borel) Makers of Patent Lead-covered and other Electric Cables, Cortaillod, Switzerland. (*Cables Cortaillod*) See Advt., p. 8

Société anonyme pour la Fabrication d'Appareils d'Eclairage, Electric Light Apparatus Makers, 46, Rue St. Leonard, Liège. (*Société Eclairage Liège*)

Société anonyme des Forges, Usines, et Fonderies de Gilly, General Engineers, Gilly, Belgium. (Aimé Robert, Manager.)

Société des Forges St. Hippolyte, Makers of Telegraph Wire, St. Hippolyte (Doubs), France

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Société Française d'Accumulateurs Électriques (Faure-Sellon-Volckmar, E.P.S.) (soc. anon.) —*in liquidation*

Société Française de Caoutchouc, Amiantes et Câbles (Martiny Limited), Makers of Electric Wires and Cables, 30, Rue de la Briche, St. Denis, France

Société Française pour l'Exploitation de la Pile, système Million, 61, Rue de l'Hotel de Ville, Lyon, France

Société Française d'Exploitation des Procédés Hermite, Owners of the Hermite System of Electric Bleaching, 4, Rue Drouot, Paris

SOCIÉTÉ FRANÇAISE DE PHYSIQUE, 44, Rue de Rennes, Paris

M. Lippmann ... ... President
M. Pellat ... ... Secretary-General
M. de la Touanne ... Secretary

Société Française des Télégraphes Sousmarins, 32, Rue de Caumartin, Paris (*Cables Paris*)

Admiral Caubet ... ... President
J. Dapelley ... ... Director

Société Française de l'Alumine pure, Aluminium Makers, 119bis, Rue Notre Dame des Champs, Paris

Société Française d'Electro-Métallurgie pour la Fabrication du Cuivre et autres Métaux par les procédés Elmore et Secrétan, Electro-Metallurgists, 14, Rue de la Pepinière, Paris, and Dives (Calvados), France

Société anonyme Franco-Belge pour la Fabrication de l'Accumulateur Tudor (Compagnie d'Electricité, 26, Rue Montagne aux-Herbes-Potagères, Brussels (*1410*); Route d'Arras Thumesnil, Lille (*téléphone*); and 19, Rue de Rocroy, Paris (*téléphone*). Works: Lille and Brussels. (*Tudor Brussels: Tudor Lille: Tudor Paris*)

Société Générale de Chemins de fer économique (soc. anon.), Traction Engineers, 52, Rue de Namur, Brussels. (*Economique Brussels*)

Société Générale d'Eclairage et de Force Motrice, Electric Light and Power Engineers and Contractors, 64, Rue de la Chaussée d'Antin, Paris

Société Générale d'Electricité, Electrical Engineers, Rue de la Bourse, Brussels

Société Générale d'Entreprises, Electric Light Engineers and Contractors, Athens, Greece. (Etienne de Fodor, Manager of Electrical Department) (*Expligsios Athens*)

Société Générale des Lampes Rationnelles à Incandescence—*now* Rationelle Compagnie Générale de Lampes Economiques à Incandescence (*q.v.*)

Société Générale des Téléphones—*now* Société Industrielle des Téléphones (*q.v.*)

Société des Générateurs à Vaporisation Instantée, system Serpollet, Makers of the Serpollet Boiler, 27, Rue des Cloys, Paris

Société Génévoise pour la Construction des Instruments de Physique, Electrical and Scientific Instrument Makers, Chemin Gourgas, Plainpalais, Geneva. (M. T. Turrettini, Manager)

Société des Globes holophanes, Engelfried & Co, 8, Rue St. Quentin, Paris

Société Impériale Polytechnique Russe, 2, Rue Panteleimonskaja, St. Petersburg

Société anonyme pour l'Industrie de l'Aluminium—*see* Aluminium Industrie Aktien-Gesellschaft

Société Industrielle d'Électricité, Electrical Engineers, 34, Rue de France, Brussels. (L. Moreau, Managing Director) (*652*)

Société Industrielle du Nord de la France, Lille (Nord), France

Société Industrielle des Téléphones (soc. anon.), (an amalgamation of the Société Générale des Téléphones and the Maison Ménier), 25, Rue du Quatre Septembre, 2, Rue des Entrepreneurs, and 7, Rue du Théâtre, Grenelle, Paris; Bezons (Seine-et-Oise); and Submarine Cable Factory, Calais

SOCIÉTÉ DES INGÉNIEURS CIVILS DE FRANCE, 10, Cité Rougemont, Paris. (Armand de Dax, Secrétaire Général)

SOCIETE INTERNATIONALE DES ELECTRICIENS, 44, Rue de Rennes, Paris. Laboratory: 12 and 14, Rue de Stael, Paris. (*For Officials and Objects, &c., see p. 686*)

Société des Lampes Homogènes Françaises, Makers of the Homogènes Françai-e Incandescent Lamp, 19, Rue Didot, Paris

Société Lilloise d'Eclairage Electrique, Electric Light Engineers and Contractors, 1, Rue Thiers, Lille (Nord), France

Société des Lunetiers, Electrical Apparatus Makers, 6, Rue Pastourelle, Paris; and at St. Michiel and Consances (Meuse), Sougeons (Oise), and Morez (Jura). (*See also* BRITISH DIVISION)

Société Lyonnaise des Forces Motrices du Rhône, Electric Light and Power Engineers and Contractors, 37, Rue de la République, Lyons, France

Société Lyonnaise de Mécanique et d'Électricité, 40, Avenue de Suffren, Paris

Société des Machines Magneto Electriques de Gramme, 52, Rue St. Georges, and 20, Rue d'Hautpoul, Paris. (Hippolyte Fontaine, Manager)

Société anonyme du Métal Delta et des Alliages Métalliques, Makers of High Conductivity Telegraph and Telephone Wires, 56, Rue de la Victoire, Paris

Société Nationale des Sciences et Arts Industrielles, 3, Rue des Pyramides, Paris

Société anonyme Papeteries de Vidalon—*see* Vidalon Paper Mills

Société Parisienne d'Eclairage et de Force par l'Electricité, Electric Light and Power Contractors, 13, Rue Lafayette, Paris. Works: 13, Rue des Filles-Dieu (lighting), and St. Owen (force)

Société Parisienne de Galvanisation (soc. anon.), Electro-Depositors, 13, Rue Planchat, Paris

Société des Petits Messagers Parisiens, 19, Rue Louis le Grand, Paris. (*See* District Messenger Company of Paris, Limited, *in* BRITISH SECTION)

Société Régionale d'Electricité (Reseau Normand), 10, Rue de Langannerie, Caen (Calvados), France. (J. Lecornu, Engineer in charge) (*Electricité Caen*)

Société Suisse pour la Construction de Locomotives et de Machines, Dynamo Makers, Winterthur, Zürich

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Société Suisse pour la Construction d'Accumulateurs Electrique *see* Schweizerische Accumulatorenbau Aktiengesellschaft

Société Suisse d'Electricité, Electrical Engineers, 1, Place Pépinet, Lausanne, Switzerland. (L. Raoux, Manager)

Société des Téléphones de Madrid, 15, Place Vendôme, Paris; and Calle Mayor, Madrid (*Teledrid Paris; Teledrid Madrid*)

Société anonyme des Téléphones de Zürich—*see* Zürcher Telephongesellschaft für Elektrotechnik

Société Téléphonique Domestique (système J. Cerpaux), Telephone Engineers and Contractors, 35, Rue du Congrès, Brussels. (M. Tedaldi, Manager)

Société anonyme de Traction Electrique (Système J. J. Heilmann), 11, Avenue Trudaine, Paris. (*Electron Paris*)

Société (anonyme) pour la Transmission de la Force par l'Electricité, Electrical Engineers and Contractors, 13, Rue Lafayette, Paris

Société (anonyme) pour le Travail Électrique des Métaux, Makers of the Laurent-Cély Accumulator, 13, Rue Lafayette, Paris. Works: 4, Quai de Seine, St. Ouen (Seine). (G. Sciama, Manager.) (*Homogens Paris, 14151*)

Somzée, Gaëtan, Electrical Engineer, 22, Rue du Palais, Brussels

Somzée, Léon, Electrical Engineer, 22, Rue du Palais, Brussels

Sorenson, S. S., Electrical Engineer, Sheba Gold Mining Co, Ltd, Eureka City, Barberton, South Africa

Soulat, J., Maker of the Soulat Electric Meter, Sançoins (Cher), France

Soulé, D., Maker of all kinds of Woodwork for Electrical Purposes, Bagnères de Bigorre (Hautes-Pyrénées); and 26, Rue de Crussol, Paris

Spain, Arthur, Electrician, A631, Boschstraat, Breda, Holland

Spangenberg & Kramer, Electrical Apparatus Makers, 19, Kl. Bockenheimerstrasse, Frankfort-on-the-Main

Spohn (J.) & Reinhardt, Electrical Engineers, 50, Augustastrasse, Stettin

Spohr, H. C., Telegraph and Telephone Engineer, 37, Gr. Friedbergerstrasse, Frankfort-on-the-Main

Sponholz & Wrede, Electrical Apparatus Makers, 6, Exerciersstrasse, Berlin, N. (*Façonteile Berlin III., 8482*)

Spring, —, Electrician, 52, Rue Beckman, Liége, Belgium

Staercke, C. F., Maker of Screws and Terminals, &c., 77, Blumenstrasse, Berlin, O.

Stahl und Eisen (semi-monthly), 14, Schadowplatz, Dusseldorf, Germany. (*Ingenieur Schroedter Dusseldorf*) (Ann. sub., 20 Marks)

Stanton, G. A., Electrical Engineer, Ferreira Gold Mining Company, Johannesburg, South African Republic

Staub (F.) Sohn, Electrical Apparatus Maker, Zug, Switzerland

Stapfer, D., Electrical Engineer, Boulevard de la Major, Marseille-Joliette, France

Stassart, Simon, Electrical Engineer, l'École des Mines, Mons, Belgium

***STEARN, C. H.**, Electrician and Managing Director of the Zürich Incandescence Lamp Company, Zürich, Switzerland. (*Stearn Engr Zurich*) **See Advt., p. 2** (*See also* BRITISH DIVISION)

Stendebach, F., Electrical Apparatus Maker, 23, Bahnhofstrasse, Plagwitz-Leipzig, Germany

Stephan, Dr. Heinrich von, Secretary of State for the Imperial German Postal Department, Berlin

Stepanow, Serge, Electrician, 4, Rue Nicolawskaia, St. Petersburg

Stettiner Elektricitäts-Werke, A.-G., Electrical Engineers, 97, Pölitzerstrasse, Stettin, Germany

Stevenson, G. E., Local Manager, Telephone Company of Egypt, Ltd, Alexandria

Stieberitz, Heinr. (Otto Brunn Nachfolger), Telegraph Apparatus Maker, 22, Josephinenstrasse, Dresden, A.

Stieltjes (Fred) & Co, Electrical Agents, 60, Boulevard de la Senne, Brussels

Stiepel, (R.), & Weimann, Manufacturers of the Gassner Dry Battery, Milan, Italy. (*Stiepel Milan*)

Stirnemann & Weissenbach, Electric Light Engineers and Contractors, Zurich, Switzerland. (*Stirnemann Zürich, 1104*)

Stock (R.) & Co, Telegraph Apparatus Makers, 29, Waldemarstrasse, Berlin, S.O.

Stöcker & Co, Electrical Engineers, 11, Erus Meyerstrasse, Leipzig-Plagwitz, Germany

Stöcker & Co, Electrical Engineers, 66, Pferdemarkt, Hamburg

Stocker, E., Electrical Apparatus Maker, Wenifelden (Thurgovie), Switzerland

Stockholms Elektricitetsverk, Stockholm. (Ad. Ahlsell, Chief Engineer)

Stogermayr, A., Electric Light Engineer, 7, Opernring, Vienna I.

*Stoletow, Dr. A., Professor of Physics in the University of Moscow, Director of the Physical Section, Polytechnic Museum, Moscow

Storari (U.) & Co, Electrical Engineers, 17-22, Via Marco Minghetti, Rome

Store Nordiske Telegraf Selskab—*see* Great Northern Telegraph Company

Strasser & Rohde, Scientific Instrument Makers, Glashütte-i.-S., Germany

Strecker, Dr. Karl, Chief Telegraph Engineer, Imperial Post and Telegraph Service, 35-36, Oranienburgerstrasse, Berlin, N., and 9, Promenadenstrasse, Gross-Lichterfelde, near Berlin

Strens, E. De, Consulting and General Engineer, Milan

Strube, A., Accumulator Maker, 19, Wallstrasse, Berlin

Studio Scientifico Industriale, Electricians, 44, Via dei Mille, Turin; 2-4, Corso Vercelli, Milan; and 36, Via Maggi, Leghorn

Stuhl, Max, Maker of the Neesen Vacuum Pump, 22, Philippstrasse, Berlin

Sturm & Co—*see* Wiener Elektrische Gluhlampen Fabrik

STUTTGARTER TELEGRAPHENDRAHT-FABRIK (A. KREIDLER), Telegraph Wire and Cable Makers, Stuttgart. **See Advt., p. 36**

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Suarez-Saavedra, Antonino, Telegraph Superintendent, Bilbao, Spain
Suchocki & Co, Electric Light Engineers, 10, Birkenstrasse, Berlin, N.W.
Süddeutsche Elektrizitäts Gesellschaft (Kommandit-Gesellschaft), Makers of Accumulators, 41, Leopoldstrasse, Munich. (*Elektro Munich, 1873*)
Suenson, Comm. Edouard (D.R.N.), Managing Director Great Northern Telegraph Company, 26, Kongens Nytorv, Copenhagen. (*Store Nordiske Copenhagen*)
Sulzer Gebrüder, Makers of High Speed Steam Engines, Winterthur, Switzerland, and Ludwigshafen-a-Rh., Germany
Swan United Electric Light Company, 11, Mittelstrasse, Kalk bei Cologne, Germany. (A. Woodley, Manager.) (*See also* BRITISH DIVISION)
Swiderski, Ph., Steam and Petroleum Engine Maker, Plagwitz, Leipzig
Swierczynski & Kass, Battery Makers, 119, Ritterstrasse, Berlin, S.
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Zeitschrift für Instrumentenkunde (monthly), published by J. Springer, 3, Monbijouplatz, Berlin, N. (Ann. sub. 18 Marks=18s.)
Zeitschrift für Physikalische Chemie, 34, Brüderstrasse, Leipzig. (Edited by Prof. Dr. W. Ostwald and Van t'Hoff.) (2 vols per annum, each 15 Marks=15s.)
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"THE ELECTRICIAN" wurde ursprünglich im Jahre 1863 gegründet, in einer Form, welche der heutigen Ausgabe ähnlich war. Nachdem diese Zeitschrift während etwa drei Jahren eine hervorragende Stellung unter den wissenschaftlichen Zeitschriften eingenommen hatte, wurde sie wieder aufgegeben, nicht ohne dass sie gezeigt hatte, dass eine solche Zeitschrift eine bedeutende Stellung unter den wissenschaftlichen und technischen Zeitschriften einzunehmen im Stande war.

In der Zeit von 1865 bis 1878 wurde "THE ELECTRICIAN" allseitig vermisst, da keine Wochenschrift welche sich mit den Interessen der Elektrotechnik befasste, vorhanden war; und so wurde der "ELECTRICIAN" von einigen Persönlichkeiten, welche ein bedeutendes Interesse an der Telegraphentechnik, dem damaligen Hauptindustriezweige der Elektrotechnik hatten, wieder von neuem ins Leben gerufen, und als das leitende Organ der elektrotechnischen Wissenschaft und Industrie begründet. "THE ELECTRICIAN" ist sonach das älteste elektrotechnische Fachblatt. Seit seiner zweiten Begründung, namentlich aber seit dem Jahre 1887 machte "THE ELECTRICIAN" rasche Fortschritte, und brachte stets in eingehender und umfassender Weise alle grossen Entdeckungen und Untersuchungen der elektrotechnischen Wissenschaft und deren praktische Verwendung zur Kenntniss seiner Leser. Die Jahrgänge des "ELECTRICIAN" sind eine wertvolle Sammlung von Original Aufsätzen und von Artikeln von beinahe allen hervorragenden elektrotechnischen Schriftstellern. Als Mitarbeiter seien unter Anderen die folgenden genannt:

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Auch alle Vorträge welche von hervorragenden Männern in den bedeutensten technischen Gesellschaften der Welt gehalten wurden, sowie die Diskussionen darüber sind im "ELECTRICIAN" zu finden.

Nicht minder bietet der "ELECTRICIAN" eine vollständige Sammlung aller juristischen Untersuchungen, welche die Gerichtshöfe in den letzten 14 Jahren beschäftigten, und "THE ELECTRICIAN" geniesst bei den Gerichtshöfen in allen elektrotechnischen Fragen ein hervorragendes authoritatives Ansehen. In dieser Beziehung, sie nur auf die Akten über die Edison- und Swan-Patente, die Kompound Wickelung-Patente, die Hoch- und Nieder-Spannungs Systeme, die Akkumulatoren-Patente, die Telephon-Patente, u. s. w., verwiesen, in welchen "THE ELECTRICIAN" als eine Authorität angezogen und von den Parteien anerkannt wurde.

Eine stehende Rubrik des "ELECTRICIAN" bilden die wortgetreuen Berichte über die Sitzungen der elektrischen Gesellschaften und Korporationen, und während "THE ELECTRICIAN" niemals die Gebiete, deren Bearbeitung den finanziellen Blättern allein gebührt, berührt hat, so bietet er andererseits allwöchentlich zuverlässige, ausführliche und vollkommen unabhängige finanzielle Berichte. Finanziellen Interessen irgend welcher Art steht er fern und sucht seine ausschliessliche Aufgabe in der Förderung der Interessen des Fachs, welchem zu dienen er berufen ist. "THE ELECTRICIAN" bringt Berichte über Versammlungen u. s. w. bis einschliesslich Donnerstags, so dass die Interessenten ihre Nummer durch die Freitag-Morgen-Post erhalten.

Die Original-Artikel des "ELECTRICIAN" werden von Männern verfasst, welche keinerlei persönliches Interesse an elektrischen Systemen haben, und deren Aufgabe lediglich in der allgemeinen Forderung der elektrotechnischen Wissenschaft und Industrie besteht. Viele dieser Original-Artikel sind inzwischen von ihren Verfassern in Buchform umgearbeitet und herausgegeben worden. Dieselben bilden den Kern der "**Electrician Series**," über welche umstehend Näheres zu finden ist.

Zählt "THE ELECTRICIAN" zu seinen Mitarbeitern die angesehensten Denker und Praktiker unserer Zeit, so finden sich seine Leser in allen Theilen der Welt, und keine englische Zeitschrift seiner Art besitzt eine so grosse Kundschaft als "THE ELECTRICIAN." Die Bände werden im Mai und November abgeschlossen, und bilden den vollständigsten Bericht über die elektrotechnische Wissenschaft und Praxis, welcher in irgend einer Sprache gefunden werden kann.

Auch für die technische Fortbildung ist "THE ELECTRICIAN" von unschätzbarem Nutzen, und hat viel zu der heutigen grossen Verbreitung elektrotechnischer Kentnisse beigetragen. Wer in der Elektrotechnik nach Ehre und Ruhm strebt, kann mit dem nimmer rastenden Laufe der Erfindungen, welche jeder Tag der Elektrotechnik bringt gleichen Schritt nicht halten ohne das fortwährende eingehende Studium der Spalten des hervorragendsten elektrotechnischen Blattes, des "ELECTRICIAN."

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VON PONCET GLASS WORKS, 54, Köpnickerstrasse, Berlin, S.O. 16. **See Advt. below**

BRACKETS AND PENDANTS, MAKERS OF.

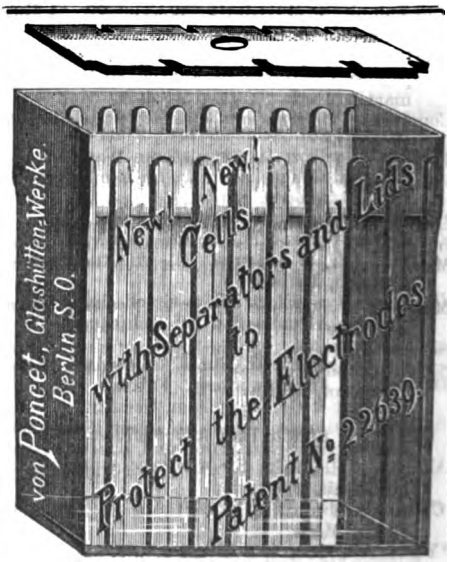
ROOTHAAN & ALEWIJNSE, 73A, Boulevard de Waterloo, Brussels

BRASS FOUNDERS (*see* **Metal Fonnders**).

CABLES, SUBMARINE (*see* **Electric Cable Makers**).

CARBON MAKERS AND DEALERS.

Armin, Tenner, 62, Zimmerstrasse, Berlin
Carré—Carré, E. E., 19, Rue de l'Estrapade, and 4, Rue des Irlandais, Paris
Compagnie Française de Charbons pour l'Electricité. 53, Rue de Chateaudun Paris
Compagnie Internationale d'Electricité, Rue des Bayards, Liége
Conradty, C., Nürnberg, Germany. (*See also* BRITISH DIVISION)
Excelsior — Rheinische Fabrik für elektrische Bogenlichtkohle (W. Grudelbach), Dinslaken-a.-Rh., Germany
Hardtmuth—Hardtmuth (F.) & Co, 1, Schegargasse, Vienna
Hennicke & Goos, 25, Neueburg, Hamburg



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Joos, Albert, Stuttgart, Germany
Kubale, C., 1, Müllerstrasse, Berlin, N.
Lacombe—Carbone, Le (soc. anon.) (anc. Lacombe & Cie), 12 and 33, Rue de Lorraine, Levallois-Perret, near Paris
Lessing, Dr. A., Nuremburg, Germany
Lévy—Berne, J. A., 67, Avenue de Maine, Paris
Mahla & Braun, Badtstrasse, Nuremburg
Mankiewitz, C., 187, Schönhauser-Allee, Berlin, N.
Mors (Emile) & Cie, 3, Rue St. Guillaume, Courbevoie (Seine), France
Nürnberger Beleuchtungs-Kohlen-Fabrik (Julius Foochs), Doos bei Nürnberg, Germany
Richtersche Fabriken, Mulda, Saxony
ROOTHAAN & ALEWIJNSE, 73A, Boulevard de Waterloo, Brussels
Rylander & Rudolphs Fabriks-Aktiebolag, Henriksborg and Stockholm, Sweden
Sautter-Lemonnier—Sautter, Harlé & Co, 26, Avenue de Suffren, Paris
Schmelzer (Ch.) Limited, Nuremburg, Germany
Siemens—Siemens & Halske, Charlottenburg, Berlin, Vienna and St. Petersburg
Winckler, O., 12, Jordanstrasse, Dresden-Neustadt
Zeller (J.) & Co, Sonthofen, Bavaria

CARBON ROD AND BATTERY PLATE MANUFACTURERS.

Bendl, Joseph, Kaufbeuren, Germany
Carbone, Le, soc. anon. (anc. Lacombe & Cie), 13 and 33, Rue de Lorraine, Levallois-Perret, near Paris

CASINGS AND CLEATS (WOOD), MANUFACTURERS OF.

Bergmann (S.) & Co, Aktien-Gesellschaft, 21, Fennstrasse, Berlin, N.
Richtersche Fabriken, Mulda, Saxony

CENTRAL STATIONS, CONTRACTORS FOR THE CONSTRUCTION AND MAINTENANCE OF.

Allgemeine Elektrizitäts Werke, 22, Schiffbauerdamm, Berlin
Baerlein, F., 40, 2°, Rua da Prata, Lisbon
Compagnie Continentale Edison, 8, Rue Caumartin, Paris
Compagnie Internationale d'Electricité, Liège, Belgium
Desroziers, E., 74, Rue Condorcet, Paris
Electrizitäts Aktien-Gesellschaft vormals, Schuckert & Co, Nürnberg, Germany
Ganz & Co, Budapest, Hungary
Imig, A. G., 23, Rue St. Gommaire, Antwerp
Maschinenfabrik Oerlikon, Oerlikon bei Zürich, Switzerland
Murdoch & Haldane, Pretoria, South African Republic
Siemens & Halske, 93, Markgrafenstrasse, Berlin
Société (anonyme) Electricité et Hydraulique, Charleroi, Belgium

CHEMISTS, CONSULTING AND MANUFACTURING.

Aktien-Gesellschaft für Chemische Industrie, Mannheim, Germany
Chemische Fabrik Elektron A.-G., Frankfort-on-the-Main
Coignet & Co, St. Denis, Paris
Dasnières, C., 54, Rue de la Victoire, Paris
Knöfler (Dr. O.) & Co, 24, Englischestrasse, Charlottenburg, Berlin
Marcus, Seigfried, 4, Mondscheingasse, Vienna VII.
Saacke, A. C., Hamburg, Germany. (Exporter and Importer)

CLAMPS FOR CONDUCTING WIRE, MAKERS OF.

KÜCKE (W.) & CO, Elberfeld, Germany. **See Advt., p. 541**

CLIMBING SHOES, MAKERS OF.

KÜCKE (W.) & CO, Elberfeld, Germany. **See Advt., p. 541**

CONDUITS, MANUFACTURERS OF.

Aktiengesellschaft für Monierbauten, 97, Alt Moabit, Berlin, N.W
Canler, Eugène, Calais, France
FELTEN & GUILLEAUME, Carlswerk, Mülheim-on-Rhine, Germany. (W. F. Dennis & Co, 11, Billiter-st, London, Sole Agents.) **See Advt., p. 9**
Léon (A.) Aîné & Frère, 11, Cours du Chapeau-Rouge, Bordeaux, France
Lexow, A., 40–43, Dresdenerstrasse, Berlin, S.

CRANES AND HOISTS, MAKERS OF

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DRILLING MACHINES, MAKERS OF.

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Breton, L., 28, Rue de Lyon, Paris
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Franck & Co, Schlettstadt-i-E. Germany
Hüttlinger, J. L., Schwabach, bei Nuremberg
ROOTHAAN & ALEWIJNSE, 73A, Boulevard de Waterloo, Brussels

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Alioth—Alioth (R.) & Co, 43 and 45, Claragraben, Basle, Switzerland
Berlin—Allgemeine Elektricitätswerke, 22, Schiffbauerdamm, Berlin
Berliner Maschinenbau Aktien-Gesellschaft, 17 and 18, Chausseestrasse, Berlin, N.
Bietrix & Cie, Saint-Etienne (Loire), France
Bouton (G.) & Cie, 5 and 7, Rue Nicolai, Brussels
Brown—Brown, Boveri & Co, Baden, Switzerland
Bürgin—Bürgin, Emile, 18, Unterer Rheinweg, Basle, Switzerland
Cail—Société des Anciens Etablissements Cail, Paris
Carré, F. P. E., 48, Rue de Neuilly, Paris
Chertemps—Chertemps, D. A., Passage St. Sebastien, Paris

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——— Burghardt Gebrüder, Mulhausen, Elsass, Germany
——— Desroziers, E., 74, Rue Condorcet, Paris
Ducrotoy (J. B.) & Co, 6, Rue du Marché, Popincourt, Paris
Dulait—Société (anonyme) Electricité et Hydraulique, Charleroi, Belgium
——— Pitot, L., 39, Rue de Châteaudun, Paris
Dusseldorfer Elektromotorenfabrik, Bünger & Co, Dusseldorf
Eckelt, J. L. C., 3, Müllerstrasse, Berlin, N.
Elsässische Elektricitäts-Gesellschaft (Otto Schulze & Isenbeck), Strasburg, Alsace
Elwell, T., 223, Avenue de Paris, Plaine St. Denis (Seine), France
Exploseur—Manet Frères, 161, Rue Lecourbe, Paris
Fein—Fein, C. & E., Telegraphenbau-Anstalt, Stuttgart, Germany
Fischinger—Kummer (O. L.) & Co, Niedersedlitz bei Dresden, Germany
Fraas Gebrüder, 2, Traverse du Chapitre, Marseilles, France
Fritsche—Fritsche & Pischon, 4, Am Kupfergraben, Berlin, W.
Gramme—Société (anonyme) L'Éclairage Électrique, 250, Rue Lecourbe, Paris
——— Société des Machines Magneto-Electriques Gramme, 52, Rue St. Georges, Paris
Hefner-Alteneck—Siemens & Halske, 93, Markgrafenstrasse, Berlin
Helios Company, Ehrenfeld-Cologne, Germany
Helvetia—Alioth (R.) and Co, Basle, Switzerland
Hillairet-Huguet — Società Nazionale delle officine di Savigliano, Savigliano, and Turin, Italy
Hoho—Société L'Eléctrique, 279, Chaussée d'Anvers, Brussels; and 23, Rue de Bac, Paris
Ilïyne-Berline, S., 5, Rue Réaumur, Paris
Janin (Louis) & Co, 86, Rue de la Charité, Geneva
Jaspar—Jaspar, J., 20, Rue Jonfosse, Liège, Belgium
Koechlin—Ateliers de Construction Vevey, Vevey, Switzerland
Labour—Société l'Eclairage Electrique, 250, Rue Lecourbe, Paris
Lahmeyer—Deutsche Elektrizitäts-Werke zu Aachen, Aachen, Germany.
Lavo—Mors, L., 8, Rue des Marronniers, Paris
———Lavo, G. Aug., 48, Villa Chaptal, Levallois-Perret (Seine), France
Marcel Deprez—Société Anonyme d'Eclairage et de Force par l'Electricité, 13, Rue Lafayette, Paris
Marioni—Zürcher Telephongesellschaft (Actiengesellschaft für Electrotechnik), Zürich (Aussersihl), Switzerland
Méritens—Société Industrielle d'Electricite, 44, Rue Boursault (Batignolles), Paris
Miot—Mégy, Echeverria & Bazan, 72, Boulevard Haussmann, Paris
Möhring & Co, Frankfort-on-the-Main
Mondos—Mondos, R. L. P. B., 56, Rue Notre-Dame-de-Lorette, Paris
OERLIKON — Maschinenfabrik Oerlikon, Oerlikon bei Zürich, Switzerland
Patin—Patin (O.) & Co, 11 and 13, Rue Théophile Gautier, Paris
Pieper—Compagnie Internationale d'Électricité, Rue des Bayards, Liège, Belgium
Pöge, Hermann, 88, Zwickauerstrasse, Chemnitz, Germany
Postel-Vinay, A., 38, Rue Vaneau, Paris
Radanker—Fritsche & Pischon, 4, Am Kupfergraben, Berlin, N.
Rechniewski—Société (anonyme) L'Éclairage Electrique, 250, Rue Lecourbe, Paris
Reignier—Reignier (Ch.) & Parrot (G.), 4, Rue Vicq d'Azir, Paris
Reutlinger—Brescius, Emil, Rödelheims, Frankfort-on-the-Main
Rivolta (C.) & Co, 42, Via Lazzaro Spallazania, Milan, Italy
Rouart Frères et Cie, 137, Boulevard Voltaire, Paris
Saint (A.) & Cie, 93, Rue Oberkampf, Paris
Sautter-Lemonnier—Sautter, Harlé & Co, 26, Avenue de Suffren, Paris
Schuckert — Elektrizitäts Aktien-Gesellschaft vormals Schuckert & Co, Nürnberg.
Société Suisse pour la Construction de Locomotives et de Machines, Winterthür, Zurich
Thury—Compagnie de l'Industrie Electrique Genève, Geneva
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Zipernowsky-Déri-Blathy—Ganz & Co, Budapest, Hungary
——— Schneider & Co, Usines de Creusot (Saône-et-Loire), and 1, Boulevard Malesherbes, Paris
——— Planas, Flaquer & Co, Gerona, Spain

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Carpentier, Jules, Lille (Nord), France. (Lead Cables)
Cuenot, Celestin, 182, Boulevard de la Villette, Paris
Feller, Josef, 54, Kaiserstrasse, Vienna, VII.
FELTEN & GUILLEAUME, Carlswerk, Mülheim-on-Rhine, Germany. (Agents, W. F. Dennis & Co, 11, Billiter-st, London, England.) **See Advt., p. 9**
François, Grellou et Cie, 43, Rue des Entrepreneurs, Paris
Geoffroy & Delore, 28, Rue des Chasses, Clichy-la-Garenne (Seine), France
Goeters, R. & G., Odenkirchen, Rheinprovinz, Germany
Grammont, E. C., Pont-de-Chérui (Isère); and 10, Rue Taitbout, Paris
Heddernheimer Kupferwerke vormals F. A. Hesse Söhne, Heddernheim, near Frankfort-on-the-Main
Hen (Léon) & Co, 10, Rue Stéphenson, Brussels-Schaerbeek
Heyl (G. E.) & Co, 101, Leipzigerstrasse, Berlin, S.W. Works: Charlottenburg and Augsburg
Hirschmann, Siegfried, 72, Landsbergerstrasse, Berlin, N.O.
Houry, —, 22, Rue du Pont Neuf, Paris
India Rubber, Gutta Percha and Telegraph Works Company (Limited), Persan-Beaumont, France. (*See also* BRITISH DIVISION)
Larsonneau frères & Cie, 29, Rue des Cloys, Paris
Mayol & Co, Gerona 95, Barcelona, Spain
Perci & Schacherer, 21, Szigony-utcza, Budapest, Hungary VIII.
Pirelli & Co, Telegraph Works, Milan; and Spezia
Risse & Schöneberg, Iserlohn, Germany
ROOTHAAN & ALEWIJNSE, 73A, Boulevard de Waterloo, Brussels
Schaefer, Oscar, Rheinish-Westfalisches Kabelwerk, Duisburg a.-Rh., Germany
Siemens & Halske, Charlottenburg, Berlin, Vienna and St. Petersburg.
Société anonyme des Anciens Etablissements Cail, 15, Quai de Grenelle, Paris. (Makers in France of Berthoud-Borel Cables)
SOCIETE D'EXPLOITATION DES CABLES ELECTRIQUES (Système Berthoud-Borel), Cortaillod, Switzerland. **See Advt., p. 8**
Société Française de Caoutchouc, Amiantes et Câbles (Martiny Limited), 30, Rue de la Briche, St. Denis, France
STUTTGARTER TELEGRAPHENDRAHT-FABRIK (A. KREIDLER), Stuttgart. **See Advt., p. 36**
Tedeschi (V.) et Cie, 101, Barriera di Lanzo, Turin, Italy. (Telegraph)
WEILLER (LAZARE) et CIE, 52, Boulevard Malesherbes, Paris. **See Advts., pp. 746 773 and 775**
Winiwarter, G., 22, Johannesgasse, Vienna, I.
Yamada Yoshichi, 19, Takashimacho Ninth-st, Yokohama, Japan

ELECTRIC CLOCKS, MAKERS OF.

Bueninck (J. O.), & Co, 14, Rue Fontaine St. Georges, Paris
Fabrik Elektrischer Uhren & Apparate Akt.-Gesellschaft, Halle a. S., Germany
Hirschmann, Siegfried, 72, Landsbergerstrasse, Berlin, N.O.
Mehne, J. G., Schwenningen, Württemb. Schwarzwald, Germany
Paris, Ad., 91, Konigstrasse, Altona, Germany
Peyer, Favarger & Cie, 9, Rue des Terraux, Neuchâtel, Switzerland
Stiepel (R.) & Weimann, 8, Via S. Martino, Milan, Italy
Wehrlé, E., 2, Place du Petit Sablon, Brussels

ELECTRIC CRANES AND LIFTS, MAKERS OF.

Collet and Engelhard, Offenbach-on-the-Main, Germany
Flohr, Carl, 28B, Chausseestrasse, Berlin, N.
MASCHINENFABRIK OERLIKON, Oerlikon bei Zürich, Switzerland
Megy, Echeverria & Bazan, 72, Boulevard Haussmann, Paris
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L'Électrique (Société anonyme), 279, Chaussée d'Anvers, Brussels
Müller, C. H. F., 14, Bremerstrasse, Hamburg
Rodewald & Co, 41, Gr. Packhofstrasse, Hanover
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Allgemeine Österreichische Elektricitäts-Gesellschaft, 6, Neubadgasse, Vienna
Allmänna Svenska Elektriska Aktiebolaget, Westeras and Stockholm, Sweden
Arndt, J., 75, Fleischhauerstrasse, Lübeck, Germany
Bartelmus, R., Brünn, Austria
Bartels (Franz) & Co, Dantzig
Bartzsch & Co, 11, Stephanstrasse, Berlin, N.W.
Bède (E.) & Co, 37, Rue Philippe-le-Bon, Brussels
Beeckmann, R., 18, Beckmannshofstrasse, Barmen, Germany
Begas (Paul) & Co, 17, Grosse Eschenheimerstrasse, Frankfort-on-the-Main
Berliner Electrotechnische Fabrik Bauer & Betz, 36, Neue Friedrichstrasse, Berlin, C.
Berliner elektrische Beleuchtungs-Aktiengesellschaft, 28, Alexanderstrasse, Berlin, O.
Berner, Otto, 3, Steinhöft, Hamburg
Boeddinghaus, Julius, 20, Stefanienstrasse, Dusseldorf, Germany
Bremen (L. von) & Co, 30, Rödingsmarkt, Hamburg, Germany
Borcherding, James, 132, Postfo, Bremen, Germany
Börner & Herzberg, 14, Bernburgerstrasse, Berlin, S.W.
Brumm, G., 1, Löwenstrasse, Offenbach-on-the-Main, Germany
Buchner, C., 46, Friedrichstrasse, Wiesbaden
Budapester Allgemeine Elektricitäts-Gesellschaft, Budapest
Büsch, R., 2, Kl. Johannisstrasse, Hamburg
Calvert & Co, Gothenburg, Sweden
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Cattoir, Geo., Rue du President, Brussels
Chertemps, D. A., 11bis, Passage St. Sebastien, Paris
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Compagnie Centrale d'Electricité (soc. anon), 14, Rue des Archers, Lyons
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Compagnie d'Éclairage Électrique du Secteur des Champs-Elysées (Mildé & Cie), 52, Rue du Faubourg St. Honoré, Paris
Compagnie Electrique de la Loire, St. Etienne, France
Compagnie Electrothermique, 50, Rue de la Chaussée d'Antin, Paris
Compagnie Générale de Travaux d'Eclairage et de Force (anc. maison Clémançon), 23, Rue Lamartine, Paris
Compagnie Hydro-Electrique, 59, Place de Meir, Antwerp
Compagnie Parisienne de l'Air Comprimé et de l'Electricité Procéde Victor Popp (soc. anon.), 54, Rue Etienne Marcel, Paris
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Compañia General Madrilena de Electricidad, 33, Carrera San Jeronimo, Madrid
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Edel, E., 116, Dresdenerstrasse, Berlin, S.
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Elektrisk Bureau, 3, Dokvelen, Christiania
Elektrizitäts-Gesellschaft, Admiralitätshof, Hamburg, Germany
Fagard, Pierre, 15, Quai d'Amercœur, Liège, Belgium
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Fortin, Hallais & Cie (société departmentale d'Electricité), 1bis, Rue des Ursines, Vire (Calvados). France
Française, La (Compagnie d'Electricité), 17, Rue le Peletier, & 81, Rue Claude-Bernard, Paris
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Frölich & Perthen, 14A, Beatrixgasse, Vienna, VII.
Frühmsfeld & Co, 16, Woltmannstrasse, Hamburg
Ganz & Co, Budapest, Hungary; and Vienna
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Glass, H., 16, Grosse Flurstrasse, Barmen, Germany
Gmür Gebrüder, Schannis, St. Gall, Switzerland
Gondin & Théard, 166, Rue de Charonne, Paris
Grubert & Sohn, 31, Krausenstrasse, Berlin, S.W.
Guichard, P. A. L., 118, Rue de Meaux, Paris
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Hauschild, M., 11, Simeonstrasse, Berlin, S.W.
Hechler, S., 14, Luisenstrasse, Mulhausen, Thuringia, Germany
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Internationale Druckluft und Elektrizitäts Gesellschaft, Unter den Linden, Berlin, W.
Julia, Ramis, Guillamot y Cia, 90, San Pablo, and 32, Riereta, Madrid
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Khern, J., 5, Marienstrasse, Halle a.-d.-S., Germany
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Moses, L., 36, Auguststrasse, Berlin, C.
Moyé & Stotz, Mannheim, Germany
Müller, C. H. F., 14, Bremerstrasse, Hamburg
Naglo Gebrüder, 44, Waldemarstrasse, Berlin, S.O. *After April:* Köpenicker Landstrasse, Berlin, S.O.
Naze, F., 9, Avenue de l'Opéra, Paris
Nederlandsche Maatschappij voor Electriciteit en Metallurgie, s'Gravenhage, Amsterdam
Ochse, Albert, 28, Wirichsbongardstrasse, Aachen
Oesterreichische Electricitäts Gesellschaft, Vienna
Oesterreichische Waffenfabriks-Gesellschaft Steyr, 15, Schottenring, Vienna
Pabst, Ernst, 13, Escherstrasse, Hanover
Perreur-Lloyd & Co, 16, Boulevard Jourdan, Paris
Plücken, Gottfried, 19, Luth. Kirchstrasse, Crefeld, Germany
Porta, Ravizza & Co, 3, Via Savona, Milan
Pretoria Lighting Company, Limited, Pretoria, South African Republic
Quaglia & Cia, 27, Via Berthollet, Turin
Riffarth, M., 12, Klosterstrasse, München-Gladbach, Germany
Reisser, Wilh., 13A, Wilhelmsplatz, Stuttgart
Rogge (P.) & Co, 14, Bikhofstrasse, Breslau
Rümpler, J. M., 24A, Altonaerstrasse, Berlin, N.W.
Rouma (A.) & Co, 60, Rue Vert Bois, Liège, Belgium
Sack (Daniel) & Co, 55, Rue Legendre, Paris
Sage & Co, 83, Rue Truochet, Lyons, France
Sautter, Harlé & Co, 26, Avenue de Suffren, Paris
Schaller, G., 33, Rothenburgerstrasse, Nuremberg
Scheidhauer, F., 57, Sidonienstrasse, Leipzig
Schmidt, O. B., 2, Schloss-strasse, Chemnitz, Saxony
Schorch (Max) & Co, 8, Friedrich Wilhelmstrasse, Rheydt, Germany
Shorton & Easton, 97, Grabschnerstrasse, Breslau, Germany
Siam Electric Light Company, Limited, Bankok
Siemens & Halske, 94, Markgrafenstrasse, Berlin, and Charlottenburg, Germany; 14, Apostelgasse, Vienna III.; and St. Petersburg
Sierra y Alonso, Ildefonso, 8², Calle de Echegaray, Madrid
Smit (Willem) & Co, Slikkerveer, Holland
Società Elettrica Industriale Franco-Italiana, 2 Via Meravigli, and 5, Via Dante, Milan, Italy
Società Generale Italiana di Elettricità (Sistema Edison), Milan, Italy
Società Nazionale delle officina di Savigliano, Savigliano, and Turin, Italy
Société anonyme d'Eclairage Electrique de l'Ilot Tolzan, 31, Rue du Puits-Gaillot, Lyons
Société Electrique de Vevey-Montroux, Vevey-Montroux, Switzerland
Société (anonyme) Belge pour l'Éclairage et Transmission Electrique à Longue Distance, 56, Rue des Bouchers, Brussels
Société (anonyme) d'Eclairage et de Force par l'Electricité, 13, Rue Lafayette, Paris
Société d'Eclairage electrique de Bordeaux et du Midi, 5, Cours de l'Intendance, Bordeaux
Société d'Eclairage électrique du Secteur de la Place Clichy, 53, Rue des Dames, Paris
Société (anonyme) l'Electrique, 279, Chaussée d'Anvers, Brussels; and at Paris
Société (anonyme) Électricité, 39, Avenue Marceau, Courbevoie (Seine), France
Société d'Electricité Souchier & Cie, 4, Rue des Recollettes, Marseilles
Société Generale d'Eclairage et de Force Motrice, 64, Rue de la Chaussée d'Antin, Paris
Société Internationale d'Électricité, Rue des Bayards, Liège
Société Lilloise d'Eclairage Electrique, I, Rue Thiers, Lille (Nord), France
Société Lyonnaise des Forces Motrices du Rhône, 37, Rue de la Republique, Paris
Société Lyonnaise de Mécanique et d'Électricité, 40, Avenue de Suffren, Paris
Société Parisienne d'Eclairage et de Force par l'Electricité, 13 Rue Lafayette, Paris
Société Regionale d'Electricité (Reseau Normand), 10, Rue de Langannerie, Caen (Calvados), France
Société (anonyme) pour la Transmission de la Force par l'Electricité, 13, Rue Lafayette. Paris
Stirnemann and Weissenbach, Zürich
Stockholms Elektricitetsverk, Stockholm
Stogermayr, A., 7, Opernring, Vienna I.

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Tafel, Victor, 14, Wallstrasse, Freiburg, Baden, Switzerland
Thiergärtner, A. E., 5, Merkurstrasse, Baden, Germany
Tsaut & Hostache, Lausanne
Vaillant, A. fils, Barjols (Var), France
"Volta" Compañia General de Electricidad, 4, Rio de la Pila, Santander, Spain
Wilhelm, L., 2A, Leipzigerstrasse, Hanau, Germany
Winkler & Reich, 6, Konigsegg-Gasse, Vienna
Witte (J.) & Vogt, 6, Böckmannstrasse, Hamburg
Wockatz & Co, Gothenburg, Sweden
Zink & Potthoff, 75, Rödingsmarkt, Hamburg

ELECTRIC LIGHT FITTINGS MAKERS.

Aktien-Gesellschaft für Fabrikation von Broncewaaren und Zinkguss, 9, Wasserthorstrasse, Berlin, S.
Aktien-Gesellschaft Schaeffer and Walcker, 18, Lindenstrasse, Berlin, S.W.
BOUDEWIJNSE, JOHAN, Middelburg, Holland. See Advt., p. 15
Campe & Co, 24, Seydelstrasse, Berlin, C.
Dudach & Roux, 25, Rue Notre Dame de Nazareth, Paris
Établissements L. Liotard jeune, 22, Rue de Lorraine, Paris
Frister, R., 23, Lindenstrasse, Berlin, S.W.
Galy, H., 8 and 10, Rue Ternaux, Paris
Gläser, H., 38, Uniongasse, Vienna
Guyennet, A., 25, Rue du Faubourg St. Jacques, Paris
Hastray, P., 14, Rue Melseu, Brussels
Léon, Albert, 5, Impasse Gaudelet, Paris
Mildé (Ch.), fils et Cie, 26, Rue Laugier, Paris
Pavesi (V.) & Ca, 4, Silvio Pellico, Milan
Rey frères, 60, Rue Veeweyde, Anderlecht, Brussels
Richter, E. & F., 44, Josefstädterstr., Vienna
ROOTHAAN & ALEWIJNSE, 73A, Boulevard de Waterloo, Brussels
Sächsische Broncewaarenfabrik Aktien-Gesellschaft, Badergraben, Wurzen i. S.
Schaefer & Hauschner, 233, Friedrichstrasse, Berlin, S.W.

ELECTRIC LIGHT SYSTEMS.

Alioth (R.) & Co, Basle, Switzerland
Allgemeine Elektrizitäts Gesellschaft, 22, Schiffbauerdamm, Berlin, N.
Compagnie Continentale Edison, 28, Rue de Chateaudun, Paris
Compagnie Internationale d'Electricité, 18, Rue des Bayards, Liége
Deckert & Homolka, 34, Favoritenstrasse, Vienna, IV.
Elektrizitäts Aktien-Gesellchaft vormals Schuckert & Co, Nuremburg.
Ganz & Co, Budapest, Hungary
MASCHINENFABRIK OERLIKON, Oerlikon bei Zürich, Switzerland
Siemens & Halske, Charlottenburg, Berlin, Vienna, and St. Petersburg
Société (anonyme) l'Éclairage Electrique, 250, Rue Lecourbe, Paris
Société (anonyme) Électricité et Hydraulique, Charleroi, Belgium
Société des Machines Magneto-Electriques de Gramme, 52, Rue St. Georges, Paris

ELECTRIC LIGHT WIRES, MAKERS OF.

Adrian, F., 24, Wasserthorstrasse, Berlin, S.
De la Mathe (B.) & Cie, Argenteuil (Seine-at-Oise): and 52, Rue de Dunkerque, Paris
De Schamphelaere, Pol., 19, Rue des Champs, Ghent, Belgium
Desclercs, —, 75, Rue Turbigo, Paris; and Courtelan, par Faremoutiers (Seine-et-Marne), France
Ferro-Nickel, Le (soc. anon.), Lizy-sur-Ourcq (Seine-et-Marne), France
Frankfürter Telegraphendraht und Kabelfabrik (Emil Blust), 129, Hainerweg, Frankfort-on-the-Main
Pavoux & Co, 14, Rue de Launoy, Brussels
SOCIÉTÉ D'EXPLOITATION DES CÂBLES ELECTRIQUES, Cortaillod, Switzerland. See Advt., p. 8
STUTTGARTER TELEGRAPHENDRAHT-FABRIK (A. KREIDLER), Stuttgart. See Advt., p. 36

LAZARE WEILLER,
Telephonic and Telegraphic Engineer,
CONSTRUCTOR & CONTRACTOR
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Manufacturer of all sorts of Improved
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Mills at Angoulême (Charente).
SOLE AGENCY AND DEPÔT
(for Great Britain and the Colonies):
FERNAND ESPIR,
8, East India Avenue, London, E.C.

ELECTRIC MEASURING INSTRUMENTS.

Desroziers, E., 74, Rue Condorcet, Paris
MEYER, DR. PAUL, 67, Holzmarktstrasse, Berlin, O. See Advt., p. 641

ELECTRIC MOTORS, MAKERS OF.

Bon & Lustremant, 24, Rue du Faubourg Poissonnière, Paris
Desroziers, E., 74, Rue Condorcet, Paris
Electrique, L' (Société anonyme), 245, Chaussée d'Anvers, Brussels
Lahmeyer — Deutsche Elektricitäts-Werke zu Aachen, Aachen, Germany
MASCHINENFABRIK OERLIKON, Oerlikon bei Zürich, Switzerland
Routin—Ducretet (E.) & Lejeune (L.), 75, Rue Claude Bernard, Paris
Siemens & Halske, Berlin, Charlottenburg, Vienna, and St. Petersburg

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Société Decauville Aîné, 13, Boulevard Malesherbes, Paris. Works: Petit-Bourg (Seine-et-Oise), France; and Diano Marina, near Genoa
Société (anonyme) Electricité et Hydraulique, Charleroi, Belgium

ELECTRIC RAILWAYS AND TRAMWAYS, MAKERS OF AND CONTRACTORS FOR.

(*See also* **Railway and Tramway (Electric) Engineers and Contractors.**)

Julien, Ed., 101, Rue du Commerce, Brussels
Métallurgique, La (Soc. Anon. de Construction), 1, Place de Louvain, Brussels
MASCHINENFABRIK OERLIKON, Oerlikon bei Zürich, Switzerland

ELECTRIC REGULATORS, MAKERS OF.

Macquaire & Street, 60, Rue la Boëtie, Paris
MEYER, DR. PAUL, 67, Holzmarktstrasse, Berlin, O. **See Advt., p. 641**
Pingault, Adolf, 25, Rue St. Sébastien, Paris

ELECTRIC SAFETY LAMPS, MAKERS OF.

NEWBOLD, H., 143, Rue St. Antoine, Paris
Maker of Incandescent Lamps of all patterns, voltages and intensities.

ELECTRIC STORES, EXPORTERS OF.

Desroziers, E., 74, Rue Condorcet, Paris
Lofquist, Hjalmar, 6, Teatergatan, Stockholm

ELECTRIC TANNING SYSTEMS.

GROTH, L. A., M.R.I., La Tannery Electrique, Orbe, près Lausanne, Switzerland. (*Groth Orbe Suisse.*)
Inventor of Groth's System of Electric Tanning, awarded Gold Medal Paris, and Silver Medal, London, 1893.

ELECTRIC TRACTION ENGINEERS.

Davies, J. Hubert, M.I.E.E., M.I.M.E., Farrar's bldgs, Simmonds-st and P.O. Box 455, Johannesburg, South African Republic
Enterprise de Tramways et Chemins de fer Electriques, 5, Rue Colbert, Marseilles
Mackley, Carl Thomas, Ueberlingen am Bodensee, Baden, Germany
MASCHINENFABRIK OERLIKON, Oerlikon bei Zürich, Switzerland
Société (anon.) de Traction Electrique (système J. J. Heilmann), 11 Avenue Trudaine, Paris
Vloten, P. E. van, 77, Rue de la Loi, Brussels

ELECTRIC TRANSMISSION OF POWER, CONTRACTORS FOR.

Carsi, Mari y Ca, F.ª, Pascual y Genis, Valencia, Spain
Deprez, Marcel, 30, Rue des Bineiles, Sèvres, France
Desroziers, E., 74, Rue Condorcet, Paris
Ganz & Co, Budapest and Vienna
Mackley, Carl Thomas, Ueberlingen am Bodensee, Baden, Germany
MASCHINENFABRIK OERLIKON, Oerlikon bei Zürich, Switzerland
Siemens & Halske, 93, Markgrafenstrasse, Berlin, St. Petersburg and Vienna

ELECTRIC TRAMWAY AND RAILWAY SYSTEMS.

Allgemeine Elektrizitäts Gesellschaft, 22, Schiffbauerdamm, Berlin
Desroziers, E, 74, Rue Condorcet, Paris
Ganz & Co, Budapest
Société (anonyme) de Traction Electrique, 11, Avenue Tuidaine, Paris (Heilmann)

ELECTRIC WELDING APPARATUS, MAKERS OF.

Julien, Ed., 101, Rue du Commerce, Brussels
Société (anonyme) pour le Travail Électrique des Métaux, 19, Rue Lafayette, Paris

ELECTRICAL AGENTS.

Adams, C., 143, Boulevard de la Senne, Brussels. (Representative in Belgium of Messrs. Saxby & Farmer)
Agémian Frères, 14, Ziver bey Han, Constantinople
Avril, L. C. R., 5, Quai Valmy, Paris (Telephones)
Cadiot (E. H.), & Co, 44, Rue Taitbout, Paris
Compañia General de Electricidad, Madrid. (Siemens and Halske)
COUSENS, R. LEWIS, P.O. Box 1161, Johannesburg, S. Africa. (Agent for Woodhouse and Rawson United, Limited, and for the Publications of "THE ELECTRICIAN" PRINTING AND PUBLISHING COMPANY, Limited)
CROIZIER, A. H., 3, Rue Halévy, Paris (Agent for Willans & Robinson, Limited)
Dietrichs & Löffelhardt, 16, Bremerstrasse, Hamburg
Durr, Robert, 147, Rue Masui, Brussels
Électrique, L' (Société anonyme), 279, Chaussée d'Anvers, Brussels
Elektrisk Bureau, 4, Boldhusgade, Copenhagen
Erfurth & Sinell, 7, Neuenbergerstrasse, Berlin, S.W. (Deutsche Elektrizitätswerke zu Aachen)
Flaquer, Alfonso, 22, Ronda Universidad, and 10, Fontanella, Barcelona. (Agent for Messrs. Planas, Flaquer & Co. and Messrs. Babcock and Wilcox, Limited)
Fleischhauer & Thofehrn, 1, Lützowstrasse, Hanover
Groeneveld, Van der Poll & Co, 194, Binnen-Amstel, Amsterdam. (Agents for the Lahmeyer Dynamo and Electric Motor)
Heilmann & Sack, Mulhouse, Alsace
Hepner, Siegfried, 9, Kaiser Friedrichstrasse, Schoeneberg, Berlin, W.
Holwech, Olaf M., Fredriksstad, Norway
Jordan, Ernest, 20, Esterhazygasse, Vienna, VI
Kabisch, L., 16, Belfortstrasse, Carlsruhe, Baden, Germany (Siemens & Halske)
Kirby (Edgar) & Co, Alexandria, Egypt
Klager-Illig, H., Zeil 76, Frankfort-on-the-Main
Kornblüh, L., 3, Helferstorferstrasse, Vienna, I.
Lefebvre, Emile, 31, Boulevard Anspach, Brussels
Levy y Kocherthaler, 42, Carrera de San Jeronimo, Madrid. (Allegemeine Elektricitäts-Gesellschaft)
Mayol & Cia, Gerona 95, Barcelona, Spain

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Moller, F. W., 203, Frankfürterstrasse, Oberrad, Frankfort-on-the-Main
Pavesi (V.) & Co, 4, Via Silvio Pellico, Milan
Persicaner & Co, 7, Liebenbergergasse, and 10, Parkring, Vienna, I.
Rogers (R.) & Boulte (H.), 11, Rue St. Georges, Paris. (Agents in France for the Westinghouse System)
Schmaltz, M F., 4, Kattrepelsbrücke, Hamburg
Senator, Severin, 3A, Wilhelmstrasse, Berlin, N.
Sève, G., 19, Rue Ortelius, Brussels
Silfverberg, J., 12, Hauserplads, Copenhagen (Agent for the Zürich Incandescence Lamp Company)
Sinell, Emil, 32, Neuenbergerstrasse, Berlin, S.W. (Deutsche Elektrizitätswerke zu Aachen)
Società Electrica Industriale Franco-Italiana, 2, Via Maravigli, and 5, Via Dante, Milan
Stieltjes (Fred.) & Co, American Engineering Agency, 60, Boulevard de la Senne, Brussels
Stiepel (R.) & Weimann, Milan
Takata & Co, 18, Guiza Sanchome, Tokyo; and at Osaka and Yokohama, Japan
Tenner, Armin, 36, Zimmerstrasse, Berlin, S.W.
Thurnauer, E., 27, Rue de Londres, Paris (Representative of the General Electric Company of New York, and the Thomson-Houston International Electric Company)
Verrue, F., 9, Boulevard du Hainaut, Brussels

ELECTRICAL APPARATUS MAKERS.

Achilles, E., 4, Paulstrasse, Berlin, N.W.
Ahl, J. P., 20, Graubengasse, Frankfort-on-the-Main
Aicher & Eberhardt, 138, Silberburgstrasse, Stuttgart
Aktie-Bolag Electron, Gothenburg, Sweden
Aktiengesellschaft Butzke, 12, Ritterstrasse, Berlin, S.
Albrecht & Kampf, 28, Neue Rothofstrasse, and 70, Arnsburgerstrasse, Frankfort-on-the-Main
Alioth (R.) & Co, Basle, Switzerland
Alverguiat Frères (V. Chabaud, successor), 10, Rue de la Sorbonne, Paris
Ambrosius, J. D., 33, Stiftstrasse, Frankfort-on-the-Main
Ameye, C., Iseghem, Ghent, Belgium
Ammann, —, 35, Rorschacherstrasse, St. Gall, Switzerland
Anthiérens, A, 78, Rue de la Barriere, Bruges, Belgium
Antraigues, E. L., 12, Rue Royer-Collard, Paris
Assoyer, M., 35, Rue Le Pelletier, Paris
Aubout, Léon, 28, Rue de Belleyme, Paris
Baldini, V., 95, Via Roma, Naples
Bary, Paul, 5, Rue Gay Lussac, Paris
Bassée & Michel, 92, Rue de Bondy, Paris
Baudet, Cloris, 14, Rue St. Victor, Paris
Baumgartner, J., 2, Bleicherwyestrasse, St. Gall, Switzerland
Becker, Hugo, 3, Kleiststrasse, Berlin, W.
Becker & Schöppe, 22, Gr. Brüdergasse, Dresden
Beermann, G. & H., v. d. Schlesischen Thor, Berlin, S.O.
Beisgen, Albert, 46, Taubenstrasse, Berlin, W.
Belot, Ch., 26, Rue du Poinçon, Brussels; and 2, Passage Guenot Paris
Bendix (Ferdinand) Söhne, Landsberg-a.-d.-Warthe, Germany
Berger, Franz, 1A. Mittelstrasse, Halle a.d.S., Germany
Bergmann (S.) & Co, Aktien-Gesellschaft, 21, Fennstrasse, Berlin, N.
Berliner Lehrmittel Anstalt, 54, Oranienburgerstrasse, Berlin, N.
Besson (Aug.) & Co, 35, Boulevard des Capucines, Paris
Blanc, Charles, 45, Boulevard Richard Lenoir, Paris
Bleise (J.) & Co, 23, Kreuzbergstrasse, Berlin, S.W.
Boden, M., 9, Bautzenerstrasse, Zittau-i.-S., Germany
Böhlendorf & Völkel, 13, Luckauerstrasse, Berlin, S.
Boivin & Cie, 40, Boulevard de Magenta, Paris
Bolle, Oscar, 33, Leipzigerstrasse, Berlin, W.
Bonetti, L., 69, Avenue d'Orléans, Paris
Böttcher & Quarck, 9, Müllerstrasse, Munich
BOUDEWIJNSE, JOHAN, Middelburg, Holland. See Advt., p. 15
Bourdin, C. L., 13, Avenue de la République, Paris
Brand, —, 32, Rue Royale, Brussels
Brandli, Jacob, 19, Steinenvorstadt, Basle
Brasse, Dr. Leon, 25, Rue Chasselièvre, Rouen, France
Braun, G. P., 15, Vordere Beckschlagergasse, Nuremburg
Braunschweig, Emil, 4, Friedensstrasse, Frankfort-on-the-Main
Breguet Maison (soc. anon.), 19, Rue Didot, Paris
Buchi, —, 34, Spitalgasse, Berne
Bugnod & Garnier, 40, Rue Vaubecour, Lyons
Bugnon, —, 211, Rue de la Préfecture, Fribourg, Switzerland
Bungarten, C., 9, Poststrasse, Bonn, Germany
Caillat (A.) & Lebrun (E.), 67, Rue du Chemin Vert, Paris
Candrian & Weller, 78, Dresdenerstr., Berlin, S.
Caputo, Ernesto, 185, Str. Chiaia, Naples
Castado, G., 24, Boulevard du Nord, Brussels
Cavietzel, J., 26, Rue La Vieuville, Paris
Chaudet, Dupraz & Miauton, Clarens, près Montreux, Switzerland
Chauvin, R., 186, Rue Championnet, Paris
Christiania Elektricitetsverk, Christiania
Cohendet (A.) & Co, 166, Quai de Jemmapes, Paris
Compagnie des Fonderies et Forges de l'Horme, 8, Rue Victor Hugo, Lyon; and L'Horme, near St. Chamond (Loire), France
Czeija & Nissl, 27, Zieglergasse, Vienna
Dabisch, E. Heinr., 15, Zwickauerstrasse, Chemnitz, Saxony
Dejardin, Jules, 57, Boulevard Richard Lenoir, Paris
Delaporte (Georges) et Cie, 33, Rue Bourdonnais, Paris
De Vos, Vve, Charles, 4, Rue des Croisades, Brussels
Dietrichs & Löffelhardt, 16, Bremerstrasse, Hamburg
Digeon (Louis) & Cie (anc. soc. de Branville & Cie), 25, Rue de la Montagne Ste. Geneviève, Paris

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Douce et Cie, 116, Rue de Rivoli, and 25, Rue Sévigné, Paris
Ducousso, Th., 3, Rue St. Beuve, Paris
Ducretoy (J. B.) & Co, 6, Rue du Marché Popincourt, Paris
Ecker, W., 9, Kappelplatz, Lucerne, Switzerland
Edelmann, Dr. M. T., 82, Nymphenburgerstrasse, Munich
Ehemann, Gottfr., 31 and 33, Obere Pirkheimerstrasse, Nuremburg
Electrisk Bureau, 4, Boldhusgade, Copenhagen
Electrogénique, L' (soc. anon.), 7, Rue Godot-de-Mauroy, Paris
Erfurter Elektrotechnische Anstalt, R. Dietz, 21c, Waldengasse, Erfurt
Eriksson's (J. E.) Mek. Verkstad, Stockholm
Fabrik Elektrischer Uhren und Apparate Aktien-Gesellschaft, Halle, Germany
Federmann, P., 15, Tempelhofer-Ufer, Berlin, S.W.
Fontaine, G., 18, Rue Monsieur-le-Prince, and 24, Rue Racine, Paris
Freyeisen & Schröder, 21, Siemensstrasse, Sachsenhausen, Frankfort-on-the-Main
Fussner, H., 16, Henwaagstrasse, Erlangen, Bavaria
Gaiffe (G.) Fils, 40, Rue Saint-André-des-Arts, Paris
Gallais, A., 73, Boulevard de la Villette, Paris
Gallais, D., 3, Rue de Crussol, Paris
GALLE, RICHARD, 8, Alte Jacobstrasse, Berlin, S.W.
Garnier, Paul, 16, Rue Taitbout, Paris
Garnot, X., 55, Rue de Chateaudun, Paris
Gebhardt, Paul, 85 & 53, Prinzenstrasse, Berlin, S.
Geesbergen, —, 62 and 71, Rue de Bodeghem, Brussels
Glühlampenfabrik Hard, Zürich.
Goffint, F., 113, Square de l'Est, Nivelles, Belgium
Göteborgs Elektriska Bolaget, Gothenburg, Sweden
Gould & Co, 39, Chausseestrasse, Berlin
Griebel, P. O. F., 10, Birkenstrasse, Berlin, N.W.
Groos & Graf, 25, Urbanstrasse, Berlin, S.
Grossenbacher, —, Neugasse, St. Gall, Switzerland
Grünwald, H., 20, Buttmannstrasse, Berlin, N.
Grützer, G., 37, Neue Friedrichstr., Berlin, C.
Guérin, C., 74, Boulevard Malesherbes, and 46, Rue de Naples, Paris
Guerre & Martin, 87, Rue de Darnétal, Rouen (Seine-Inférieure), France
Haber, R., 3, Lagerhausstrasse, Aachen
Hartmann & Braun, Bockenheim, Frankfort-on-the-Main
Herre, H., 122, Oranienstrasse, Berlin, S.O.
Hesse, Theodore, 5, Liebigstrasse, Frankfort-on-the-Main
Holzhausen, M., 12, Marheimekeplatz, Berlin, S.W.
Houben (J. J.) Söhne, 12, Königstrasse, Aachen
Hugentobler, —, Weinfelden (Thurgovie), Switzerland
Iliyne-Berline, S., 5, Rue Réaumur, Paris
Jaeger & Fischer, Ludenscheid i. W., Germany
Jaro, A., 24, Schlösselgasse, Vienna, VIII.
Jenisch (P.) & Boehmer, 34, Prinzenstrasse, Berlin, S.
Jung & Lindig, Freiberg, Germany
Jungnickel (Edmund) & Co, Landau (Pfalz), Germany
Keiser & Schmidt, 20, Johannistrasse, Berlin, N.
Kesel, Georg, Gerberastrasse, Kempten, Bavaria
Kessner, Paul, 7, Yorkstrasse, Berlin, S.W.
Kinne, August, 74, Vichhorfferstrasse, Essen-Ruhr, Germany
Klein, Conr., 1 & 3, Mohrenstrasse, Nuremburg
Klemm, R., 13, Mariendorferstrasse, Berlin, S.W.
Kneipkamp, A., 3, Brillerstrasse, Elberfeld, Germany
Kressmann, C., 18A, Admiralstrasse, Berlin, S.
Krimm, O., 12, Leipzigerstrasse, Berlin, W.
Kröner, Wilh., 6, Obstmarkt, Bamberg, Bavaria
Küchenmeister, O., 79, Lindenstrasse, Berlin, S.W.
Labarre, J. B. R., 14, Rue Grétry, Brussels
Lagache, G., 129, Rue St. Maur, and 53, Passage Jouffroy, Paris
Lagazy, H., 28, Rue des Eperonniers, Brussels
Langbein, Dr. G., 62, Tauchaerstrasse, Leipzig, Germany
Laubenthal & Co, 8, Beeckstrasse, Aachen
Le Blon (Ch.) & Cie, 55, Rue La Fontaine, Paris; and Boulogne-sur-Mer
Lefèvre, L., 13, Passage St. Pierre Amelot, 52, Boulevard Voltaire, Paris
Lehmann, A., 40, Stralauerstrasse, Berlin
Liebenow and Co, 23, Alexandrinenstrasse, Berlin, S.W.
Linder & Karbaum, 8, Alte Jakobstrasse, Berlin, S.W.
Luchaire (Léon) & fils, 25 and 27, Rue Erard, Paris
Lux, Freidrich, Ludwigshafen a. Rh., Germany
Machol & Marter, 11, Wallstrasse, Berlin, C.
Magne, C., 10, Rue des Pyramides, Paris
Manufacture Universelle d'Electricité, 53, Passage Jouffroy, Paris
Marcus, Siegfried, 4, Mondscheinstrasse, Vienna, VII.
Marramarra & Cia, S. Antonio a Tarsia, Naples
Mayer & Wolf, 12, Van Swietengasse, Vienna, IX.
Mehne, J. G., Schwenningen, Württemb., Schwarzwald, Germany
Metzmacher, Franz, 78, Grabenstrasse, Essen-Ruhr, Germany
MEYER, DR. PAUL, 67, Holzmarktstrasse, Berlin, O. See Advt. p. 641
Michotte, F., 21, Rue Condorcet, Paris
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Popp (Dr.) & Becker (Dr.), Electrical Laboratory, Frankfort-on-the-Main
Powell, Legh Sylvester, 16, Rue du Maine, Asnieres (Seine), Paris
Price, Jas., 41, Chapoo-rd, Shanghai
Puluj, Dr. J., Imperial Polytechnic School, Prague
Queisser, —, 55, Wallstrasse, Charlottenburg, Berlin
Quindry, Prof. —, Vire (Calvados), France
Quistwater, G., 10, Impasse Diamant, Brussels
Raiken, E., 158, Rue de l'Intendant, Brussels
Ransy, A., 57, Rue du Parc, Liège
Reynier, André, 162, Faubourg Poissonnière, Paris
Riecke, Prof. Edouard, The University, Göttingen
Righi, Prof. A., Bologna, Italy
Ritter, Gaston, 7, Rue Lamandé, Paris
Ritteshaus, Prof. Trajan, 2, Bendemannstrasse, Dresden, Germany
Riva, Benito de la, 2, Rue Duler, Biarritz (Basses-Pyrénées), France
Robert, A. C., 27, Rue Notre Dame des Champs, Paris
Roeyackers, F., 78, Rue de l'Empereur, Antwerp
Roiti, Prof. Antonio, 3, Via Gino Capponi, Florence, Italy
Rolando, G. P., 23, Rue Curiol, Marseilles, France
Roosen, Alfred, 40, Rue Dupont, Brussels
Rossiter, James T., South African Trust and Finance Company, Limited, Johannesburg, South African Republic
Runk, Geo. S., 21, Fennstrasse, Berlin, W.
Rupp, Otto, Brünn, Austria
Sahulka, Dr. John, Technische Hochschule, Vienna
Salzmann, Dr. F., 22, Schiffbauerdamm, Berlin, N.W.
Sanver, C. Fr., Sprendlingen, Rheinhessen, Germany
Sayers, H. M., Companhia de Luz Electrica, Rua de Passos de Manoel, Oporto, Portugal
Schäfer & Montanus, 10, Elefantengasse, Frankfort-on-the-Main, Germany
Schmidt, Dr. Oscar, Munich
Schoentjes, Prof. H., 65, Chaussée de Courtrai, Ghent, Belgium
Serres, Prof. L., 103, Rue de Rome, Paris
Simmen, A., 55, Rue Dombasle, Paris
Sir, R., 17, Boulevarde de Strasbourg, Toulouse (Haute-Garonne), France
Sittig, Carl, 29, Lichterfelderstrasse, Berlin, S.W.
Spring, —, 52, Rue Beekman, Liège, Belgium

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Spain, Arthur, A631, Boschstraat, Breda, Holland
STEARN, C. H., Zürich Incandescence Lamp Company, Zurich, Switzerland. **See Advt., p. 2**
Suarez Saavedra, Antonino, Bilbao, Spain
Syndicat International des Electriciens, 15, Rue Drouot, Paris
Szapiro, B., Nalewki 2, Warsaw
Tanakadaté, Aikitu, Imperial University, Tokyo, Japan
Tart, Gustave, 1, Rue Vinâve d'Ile, Liège, Belgium
Thevenard, A., 1, Rue de Valois, Paris
Tietzen-Hennig, Dr. E. von, 4, Kastanien Allee, Charlottenburg, Berlin
Tillo, General Dr. A. de, President of the Mathematical Section of the Imperial Russian Geographical Society, St. Petersburg
Tobler, Dr. Adolph, Federal Polytechnic School, Winkelwiese, Zürich
Tommasi, Dr. D., 39, Rue de l'Arcade, Paris
Tong, S. C., Imperial Chinese Telegraphs, Shanghai, China
Trimborn, C., 18, Rue Floris, Brussels
Tudor frères & Schalkenbach, Château de Rosport, Grande Duchy of Luxemburg
Tulpinck, John, Burght-Antwerp, Belgium
Ulbricht, Prof. Dr. R., 30, Werderstr., Dresden
Ullmann, Jacques, 16, Boulevard St. Denis, Paris
Uppenborn, F., Editor of the *Elektrotechnische Zeitschrift*, 5, Cuxhavenerstr., Berlin, N.W.
Urbanitzky, Dr. A. Ritter von, 11, Heumühlgasse, Vienna, IV.
Uzel, Pierre, 3, Rue Guichard, Paris
Van Boekxel, A., 3, Rue Pont Madou, Ghent, Belgium
Van Tricht, Prof., Collège des Jesuites, Louvain
Van Vloten, P. E., 77, Rue de la Loi, Brussels
Varley, Cromwell O., Tangier, Morocco
Violle, J., 89, Boulevard St. Michel, Paris
Vogel, Carl, 29, Ritterstrasse, Berlin, S.W.
Voller, Dr. A., Physikalische Staatslaboratorium, Hamburg, Germany
Wadén, Dan. Joh. Hofrad, Helsingfors, Finland
Walckenaer, Charles, 9, Rue Bayard, Paris
Waltenhofen, Dr. Adalbert, Electro-Technical Institution, Vienna.
Wassmann, Jakob, 71, Rolshoferstrasse, Kalk, near Cologne
Weber, Dr. Ludw. C., Kaiserl. Regierungs Rath, 92, Königgratzerstrasse, Berlin, S.W.
Weber, Dr. H. F., Neumünster, Switzerland
Weber, Prof. Leonh., Kiel, Germany
Weiler, Prof. W., Esslingen, Germany
Wenstrom, Jonas, Allmanna Svenska Elektriska Aktiebolaget, Westeras, Sweden
Wiedemann, Prof. Gustav, University of Leipzig, Saxony
Wilén, Fritz, 19, Union-gatan, Helsingfors, Finland
Wolff, I. C., 52, Praterstrasse, Vienna, II.
Zachariae, Major E., Director of the Military Telegraph School, 31, Goltzstr., Berlin, W.
Zickler, Carl, Technische Hochschule, Brünn, Austria
ZURICH INCANDESCENCE LAMP COMPANY, Zürich, Switzerland. **See Advt., p. 2**

ELECTRICIANS (MANUFACTURING).

Antony, J., 17, Rue Henri-Martin, Paris
Böhm & Wiedemann, 25, Kaufingerstrasse, Munich
Bohm, P., 39, Klopstockstrasse, Berlin, N.W.
Bormfeldt & Salewski, 40, Jopengasse, Dantzig
Borrell, Pedro, 138-140, Calle Libertad, Villaneuva y Geltru, Spain
Bosch, R., 108, Rothebühlstrasse, Stuttgart
BOUDEWIJNSE, JOHAN, Middelburg, Holland. **See Advt., p. 15**
Brauer & Lucke, 56, Nordstrasse, Altenburg, Thuringia, Germany
Buderus & Co, 30, Emmerberg, Hanover
Chollet & Rézard, 10, Rue Bellecordière, Lyons
Danner & Orsat, 71, Boulevard Jeanne d'arc, Rouen
Delostal & Cie, 209, Rue St. Maur, Paris
Ernecke, Ferd., 112, Königgratzerstrasse, Berlin, S.W.
Fritsche & Pischon, 4, Am Kupfergraben, Berlin
Gérard (Emile) & Cie, 19 and 20, Quai d'Amercœur, Liège
Grosch, Hermann, 5, Karlsplatz, Weimar, Germany
Haberstolz, —, 39, Ritterstrasse, Berlin, S.W.
Hakon, Brunius & Co, Gothenburg, Sweden
Hartmann & Braun, Bockenheim, Frankfort-on-the-Main
Houssa (J.) & Castin, 40, Rue Froissard, Brussels
Huygens & Cie, 10, Chemin des Compagnons, Antwerp
Jarriant, Père et Fils, 15, Rue du Gazomètre, Brussels
Junghanns & Kolosche, 14, Grenzstrasse, Leipzig
Kemp & Lauritzen, 5, Nytorv, Copenhagen
Kruger, Rudolf, 41, Michaelkirchstrasse, Berlin
Langbein, Dr. G., 62, Tauchaerstrasse, Leipzig,
Lehmann (Dr.) & Mann, 65, Blumenstrasse, Berlin, O.
Lorthioz, Emile, 60, Boulevard Strasbourg, Paris
Meyer, Eug., 59, Rue Rodier, Paris
Rylander & Rudolphs Fabriksaktiebolag, Henriksborg and Stockholm, Sweden
Siemens & Halske, Berlin, Charlottenburg, Vienna, and St. Petersburg
Studio Scientifico Industriale, 44, Via dei Mille, Turin
Tudor Frères & Schalkenbach, Château de Rosport, Grand Duchy of Luxemburg
Vitrant frères, 57, Rue Caumartin, Lille (Nord), France

ELECTRICITY METERS, MAKERS OF.

Desroziers, E., 74, Rue Condorcet, Paris
GALLE, RICHARD, 8, Alte Jacobstrasse, Berlin, S.W.

ELECTRO-CHEMISTS.

Compagnie Electrochimique de St. Béron, 189, Boulevard St Germain, Paris
Czaneczik, Vinzenz, Neustadtl, Austria
Elektrochemische Werke, 22, Schiffbauerdamm Berlin, N.
Lacroix, L. E., 140, Boulevard Chave, Marseilles, France

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ELECTROLIERS, MAKERS OF.

Cahn & Bender, 40A, Waldemarstrasse, Berlin, S.O.
Campe & Co, 24, Seydelstrasse, Berlin, C.
Hess, Wolff & Co, 49, Porzellangasse, Vienna, IX.

ELECTRO-MEDICAL APPARATUS MAKERS.

Braunschweig, Emil, 4, Friedenstrasse, Frankfort-on-the-Main
GALLE, RICHARD, 8, Alte Jacobstrasse, Berlin, S.W.
Nederlandsche Maatschappij voor Electriciteit en Metallurgie, s'Gravenhage, Amsterdam

ELECTRO-METALLURGISTS.

Christofle et Cie, 56, Rue de Bondy, Paris
Desroziers, E., 74, Rue Condorcet, Paris
Heroult, P. L. T., Thury-Harcourt, Calvados, France
Juptner von Tonstorff, Baron Hanns, Oesterreichisch-Alpine Montangesellschaft, Neuberg, Austria
Leblanc & Co, 13, Rue Froissard, Paris
Secrétan, E. P., 19, Boulevard Beausćjour, Paris
Société Electro-Chimie, 4, Rue de Trevise, Paris. Works: Vallorbes (Vaud), Switzerland, and St. Michel de Maurienne, Savoie, France
Société Française d'Electro-Métallurgie pour la fabrication du Cuivre et autres Métaux par les procédés Elmore et Secrétan, 14, Rue de la Pepinière, Paris; and Dives (Calvados), France
Société Parisienne de Galvanisation, 13, Rue Planchat, Paris

ENGINES (GAS), MAKERS OF.

Adams Valve—Maschinenbau-Gesellschaft München, Munich, Bavaria
Benz—Roger, E., 52, Rue des Dames, Paris
Crossley—Pierson, J. & O. G., 47, Rue Lafayette, Paris (Agents)
Körting Gebrüder, Körtingsdorf, near Hanover; and at Berlin, &c.
Maschinenfabrik Kappel, Kappel-Chemnitz, Saxony
Otto—Gas-Motoren-Fabrik Deutz, Deutz, near Cologne
Rodier, Roche, & Sabatier, Bagnoles-sur-Cèze, France

ENGINES (HIGH-SPEED) MAKERS OF.

CROZIER, A. H., 3, Rue Halévy, Paris
MASCHINENFABRIK OERLIKON, Oerlikon bei Zürich, Switzerland
Rogers (R.) & Roulte (H.), 1, Rue St. Georges, Paris
Sulzer Gebrüder, Winterthür, Switzerland
Swiderski, Ph., Plagwitz-Leipzig

ENGINES (STEAM), MAKERS OF.

Ateliers de Contruction H. Bollinckx (soc. anon.), Brussels
Belleville—J. Belleville & Co, St. Denis (Seine), France

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ENGINES
AND
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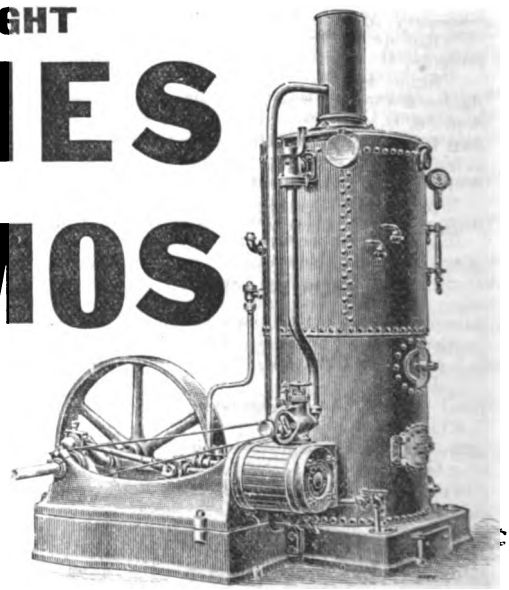

E. S. HINDLEY,
1, Queen Victoria St., London, E.C.
Works: Bourton, Dorset.
See Advertisement, Page 553.

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DAVEY, PAXMAN & CO, 111, Boulevard Magenta, Paris. (*See also* BRITISH DIVISION.) **See Advt., p. 51**
Fabrica Central, No. 480, Rua 24 de Julho, Lisbon
Garrett, Smith & Co, Magdeburg-Buckau, Germany
Maschinenbaugesellschaft Karlsruhe, Karlsruhe, Baden
Maschinenfabrik Buckau Actien-Gesellschaft, Magdeburg-Buckau
MASCHINENFABRIK OERLIKON, Oerlikon bei Zürich, Switzerland
Willans and Robinson—Croizier, A. H., 3, Rue Halévy, Paris
Wolf, R., Magdeburg-Buckau; and Berlin

ENGINEERS, CONSULTING.

Baerlein, F., 40, 2°, Rua da Prata, Lisbon
Bède, Prof. E., 37, Rue Philippe-le-Bon, Brussels
Bloxham, Edgar, 1, Rue de Compiègne, Paris
Camêré, A., 18, Rue de Douai, Paris
Dax, Armand de, 10, Cité Rougemont, Paris
Denzler, Dr. A., Fluntern-Zurich, Switzerland
Desroziers, E., 74, Rue Condorcet, Paris
De Wit, W. C. & K., 183, Prins Hendrikkade, Amsterdam
Engelfred, Arth., 8, Rue de St. Quentin, Paris
Hauman, C., 192, Boulevard de Waterloo, Brussels
Helmsky, Wilh., 9, Auerspergstrasse, Vienna, VII.
Heuschling, —, 35, Rue d'Orleans, Brussels
Hospitalier, E., Chief Editor of *L'Industrie Electrique*, 6, Rue de Clichy, Paris
Legrand, Charles, 47, Rue du Palais, Brussels
Lemonnier, C., Boulevard du Midi, Brussels
May, Dr. Oscar, 48, Oberweg, Frankfort-on-the-Main
Miller, Oscar von, 33, Nymphenburgerstrasse, Munich
Nansouty, Max de, Editor of *Le Génie Civil*, 6, Rue de la Chaussée d'Antin, Paris
Parville, H. de, Rue des Princes, Boulogne-sur-Seine, France
Raclot & Cie, 24, Rue de l'Evêque, Brussels
Somzée, Cosmo, 22, Rue du Palais, Brussels
Van Lint, Victor, 115, Rue Joseph II., Brussels
Wiesemann, E., 23, Rue du Pont Neuf, Brussels
Welz, Edouard du, 14, Rue du Chalet, St. Josse-ten-Noode, Brussels
Wunderlich (A.) & Co, 8, Boulevard Baudouin, Brussels

ENGINEERS, GENERAL.

Alberts, Alph., 7, Rue Basse Ghent, Belgium
Babcock and Wilcox, Limited, 15, Rue de la Chaussée d'Antin, Paris. (*See also* BRITISH DIVISION)
Bolibar, Gerónimo, 13, Canuda, Barcelona, Spain
Bouvier, Adolphe, 25, Avenue de Noailles, Lyons
Fein, C. & E., Telegraphenbau Anstalt, Stuttgart, Germany
Flaquer, Alfonso, 22, Ronda Universidad, and 10, Fontanella, Barcelona
Gwyther y Cañete, 135, Fuencarral, Madrid
Hald (D.) & Co, Stockholm
Hillerscheidt & Kasbaum, 44, Schönhauser-allée, Berlin, N.
Impresa Industriale Italiana di Costruzioen Metalliche (soc. anon.), Galleria Umbarto I., Naples
Jackson Hermanos, 22², Calle Arenal, Madrid
Kohlfürst, Ludw., Kaplitz, South Bohemia, Austria
Krupp, Friedrich, Essen a. d. Ruhr, Germany
Manne, J., 15, Rue de Douvres, Anderlecht-lez-Brussels
Maschinen und Armaturenfabrik Aktien-Gesellschaft, Magdeburg-Buckau, Germany
Masson, Emile, 4, Rue Sclessin, Liège, Belgium
Neuwinger, Markert & Sieffert, 67, Lothringerstrasse, Berlin, N.
Picard, Emile, 15, Rue Royale, Brussels
Pieper, Carl, 3, Hindersenstrasse, Berlin, N.W.
Piraut, J. B., 5, Rue de Merode, Brussels
Richtersche Fabriken, Mulda, Saxony
Roeyackers, F., 76 and 78, Rue de l'Empereur, Antwerp, Belgium
Schmetz, M., Hubertusstrasse, Aachen, Germany
Schneider & Co, Usines de Creusot, France
Société anonyme des Forges et Chantiers de la Méditerranée, 3, Rue Vignon, Paris
Société (anon.) des Forges, Usines et Fonderies de Gilly, Gilly, Belgium
Société Cockerill à Seraing, Seraing, near Liége, Belgium
Strens, E. de, Milan
Zacco, Bruhn and Co, Stockholm, Sweden

ENGINEERS, MECHANICAL.

(*See also* **Engineers, General.**)

Desroziers, E., 74, Rue Condorcet, Paris
Fabrica Central, No. 480, Rua 24 de Julho, Lisbon
Maschinen und Armaturenfabrik Aktien-Gesellschaft, Magdeburg-Buckau, Germany
Viesca, Francisco de la, Cadiz, Spain
Weiler, Max, Charleroi, Belgium

ENGINEERS, MINING.

(*See also* **Engineers, General.**)

Bouquié, 1, Rue de la Chapelle, St. Gervais-lez-Namur, Belgium
Desroziers, E., 74, Rue Condorcet, Paris
Gernaert, F., Rue d'Arlon, Brussels
Masson, Emile, 4, Rue Sclessin, Liège

ENGINEERS' FURNISHERS.

Holwech, Olaf M., Fredrikstad, Norway
KÜCKE (W.) & CO, Elberfeld, Germany. **See Advt., p. 541**

ENGINEERS' TOOLS, MAKERS OF.

KÜCKE (W.) & CO, Elberfeld, Germany. **See Advt., p. 541**
MASCHINENFABRIK OERLIKON, Oerlikon bei Zürich, Switzerland

ENGRAVERS.

Dujardin, G., 84, Rue Brûle-Maison, Lille (Nord), France. (*Letters and Telegrams:* Gravure Dujardin Lille)
Poyet, Louis, 17, Rue du Louvre, Paris

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FLEXIBLE CORD, MAKERS OF.

STUTTGARTER TELEGRAPHENDRAHT-FABRIK (A. KREIDLER), Stuttgart **See Advt., p. 36**

CALVANOMETERS, MAKERS OF.

Hartmann & Braun, Bockenheim, bei Frankfort-on-the-Main, Germany
Lorenz, C., 21, Prinzessinnenstrasse, Berlin, S.
MEYER, DR. PAUL, 67, Holzmarktstrasse, Berlin, O. **See Advt., p. 641**
Richard Frères, 8, Impasse Fessard, Paris

CLOBES AND SHADES, MAKERS OF.

Campe & Co, 24, Seydelstrasse, Berlin, C.
Hirsch, Janke & Co, Glashüttenwerke Weisswasser, Weisswasser-Oberlausitz; and 12, Luisen-Ufer, Berlin, S.
Kiesow & Co, 5, Mönkedamm, Hamburg. (*See also* BRITISH DIVISION.)
Reich (S.) & Co, 71, Czerningasse, Vienna, II.
Schappel, Jacob, 38, Grosse Friedbergstrasse, Frankfort-on-the-Main
Société des Globes holophanes, Englefried & Co, 8, Rue St. Quentin, Paris
VON PONCET GLASS WORKS, 54, Köpnickerstrasse, Berlin, S.O.16. **See Advt., p. 710**

INCANDESCENT LAMPS, MAKERS OF.

Aktien-Gesellschaft für elektrische Glühlampen, Husza-utcza 7, Budapest, VII.
Amelin & Renaud, 37, Rue Jean Jacques Rousseau, Paris
Americana — Società Elettrica Industriale Franco-Italiana, 2, Via Meravigli, and 5, Via Dante, Milan, Italy
Arom frères, 132, Rue de Turenne, Paris
Augé, D., 81, Rue d'Amsterdam, Paris
Belgian Electric Lamp Manufacturing Company, 23, Rue St. Gommaire, Antwerp
Bénard—Bénard (G.) & Thiberge (P.), 12 and 14, Rue Bridaine, Paris
Bifilar—Elektricitäts-Gesellschaft, Hamburg
BOUDEWIJNSE, JOHAN, Middelburg, Holland. **See Advt., p. 15**
Constantia—Constantia Incandescent Lamp Manufactory, Venloo, Holland
Cruto—Società Italiana di Elettricità, 2, Via Sta. Teresa, Turin, Italy
Deckert & Homolka, 34, Favoritenstrasse, Vienna, IV.
Edison & Swan — Compagnie Générale des Lampes Incandescentes, 1, Rue Lepelletier, Paris, and Rue de l'Orme, Ivry-sur-Seine
Egger (B.) & Co, 187, Simmeringerstrasse, Vienna, X.; and at Budapest
Electricitäts Gesellschaft Gelnhausen, Altenhasslau, bei Gelnhausen Germany
Freund, Siegfried, 34c, Arena-út., Budapest, VII. (Attorney of the Hungarian Incandescence Lamp Manufacturing Company)
Gabriel—Gabriel (F.) & Angenault (H.), Combs-la-Ville (Seine-et-Marne), and 13, Boulevard Voltaire, Paris
Gerard — Société (anonyme) d'Électricité, 39, Avenue Marceau, Courbevoie (Seine), France
Gliewe & Kügler, 40A, Waldemar-strasse, Berlin, S.O.
Glühlampen Export Fabrik, 14-24, Dorotheenstrasse, Hamburg
Sirius—Glühlampenfabrik Gebrüder Pintsch, 27, Skalitzerstrasse, Berlin, S.O.; and Fürstenwalde, Germany
Guillon, Louis, 48, Boulevard de Strasbourg, Paris
Hard—Glühlampenfabrik Hard, Zürich
Homogène Française—Société anonyme pour le Travail Electrique des Métaux, 19, Rue Didot, Paris
——— Société des Lampes Homogènes Françaises, 19, Rue Didot, Paris
Inrig, A. G. (Belgian Electric Lamp Manufacturing Company), 23, Rue St. Gommaire, Antwerp
Lane-Fox — Kremenezky, Mayer & Co, 9A, Severingasse, Vienna, IX.
L'Eternelle—Roger, E., 52, Rue des Dames, Paris
Maack, Albert, 43, Neuestrasse, Hamburg
Möhrle—Fleischhacker & Möhrle, Munich-Pasing, Germany
Müller—Dietrichs & Loffelhardt, 16, Bremerstrasse, Hamburg
NEWBOLD, H., 143, Rue St. Antoine, Paris
Maker of Incandescent Lamps of all patterns, voltages and intensities
Ohl, G. E., Hamburg, Germany
Ohlinger, F., 65, Faubourg St. Denis, Paris
Perreur-Lloyd et Co, 16, Boulevard Jourdan, Paris
PHAËTON — ROOTHAAN & ALEWIJNSE, Nijmegen, Holland. **See Advt., p. 572**
——— — ROOTHAAN & ALEWIJNSE, 73A, Boulevard de Waterloo, Brussels
Pieper—Compagnie Internationale d'Électricité, Rue des Bayards, Liège, Belgium
Philips & Co., Eindhoven, Holland
Pope—Goossens (E.), Pope & Co, Venloo, Holland
Pulsford-Triquet — Société Centrale d'Électricité (Pulsford, Triquet & Co), 10, Rue de Normandie, Asnières; and 10, Rue Taitbout, Paris. Works: Asnières and Argenteuil
Rationnelle, La, Compagnie Générale de Lampes Economiques, 64, Rue de la Chaussée d'Antin, Paris
Rheinische Glühlampen-Fabrik, Dr. M. Fremmery & Co., Oberbruch, bei Dremmen, Germany
Rivolta (C.) & Co, 42A, Via Lazzaro Spallazani, Milan, Italy
Rogier, Smagghe & Co, Breda, Holland
ROOTHAAN & ALEWIJNSE, Nijmegen, Holland. **See Advt., p. 572**
ROOTHAAN & ALEWIJNSE, 73A, Boulevard de Waterloo, Brussels
Schuckert—Elektrizäts Aktien-Gesellschaft vormals Schuckert & Co, Nürnberg, Germany
SEEL—Actien-Gesellschaft für elektrische Glühlampen (Patent Seel), 39, Chausséestrasse, Berlin, N.
———Berliner Glühlampenfabrik Hans Roder, 39, Chausseestrasse, Berlin
———Société (anonyme) pour la Construction de Lampes à Incandescence, 7, Huszár-Utcza, Budapest, VII.
Siemens—Siemens & Halske, Charlottenburg, and 94, Markgrafenstrasse, Berlin; 14, Apostelgasse, Vienna III., and St. Petersburg

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Société (anonyme) Belge pour la fabrication de Lampes électriques à Incandescence, 10, Rue Metzys, Schaerbeek, Brussels
Société (anonyme) L'Eclairage Electrique, 250, Rue Lecourbe, Paris
Star—Allgemeine Elektricitäts-Gesellschaft, 22, Schiffbauerdamm, 26, Schlegelstrasse, and 72–76, Ackerstrasse, Berlin, N.W.
Strehlenert—Karlson, A., 19, St. Annae Plads, Copenhagen, K.
Sturm—Wiener Elektrische Glühlampen-Fabrik (Sturm & Co), 3, Liechtensteinstrasse, Vienna
Victoria—Deutsche Unternehmung für Elektrische Beleuchtungs, 106, Kaiserstrasse, Karlsruhe, Germany
Volta — Usines de la Lampe Incandescence "Volta," Schaerbeek, Brussels
WATT — Electrische Glühlampen - Fabrik "Watt." 87, Grinzingerstrasse, Nussdorf, Vienna.
Wauthier. —, 1, Rue Chanzy, Asnières, Paris
ZURICH INCANDESCENCE LAMP COMPANY, Zürich, Switzerland. **See Advt., p. 2.**

INCANDESCENT LAMP SOCKETS AND JOINTS, MAKERS OF.

ROOTHAAN & ALEWIJNSE, 73A, Boulevard de Waterloo, Brussels
Société (anonyme) Electricité et Hydraulique, Charleroi, Belgium

INFLUENCE MACHINE MAKER.

Leuner, Oscar (Mechanische Institut), Dresden, Saxony

INSULATING MATERIALS, MAKERS OF.

General.

Bender (E.) & Co, 85, Boulevard du Hainaut, Brussels
Casassa (F.) Fils et Cie, 10, Rue Jacquart, Pantin (Seine), and 257, Rue St. Martin, France
Chauffier, J., Esternay (Marne), France
Emmerling, W., Nuremburg
FELTEN & GUILLEAUME, Carlswerk, Mülheim-on-Rhine, Germany. **See Advt., p. 9**
Hannoversche Caoutchouc, Gutta Percha & Telegraphen-Werke, Linden, near Hanover, Germany. (*See also* BRITISH DIVISION)
Hannoversche Gummi - Kamm - Compagnie (Actien-Gesellschaft), Hanover, Germany
Hecht Frères et Cie, 60, Rue de la Victoire, Paris
India Rubber, Gutta Percha and Telegraph Works Company, Limited, Persan Beaumont, France. (*See also* BRITISH DIVISION)
Rost (H.) & Co, Hamburg and Harburg, Germany. (Gutta Percha)
Schmitz-Jerome & Knoff, Hanover,
Tannahill (A.) & Co, 21 Mincing Lane, London, E.C.; and at Paris
Wilde (G. de) & Co, 19, Rue Jean Jacques Rousseau, Paris

INSULATOR AND BATTERY JAR MAKERS.

Campe & Co, 24, Seydelstrasse, Berlin, C.
Lipmann, Otto, Ansprung-Zoblitz, Sachs Erzgebirge, Germany (Serpentine Stone)
Porzellanfabrik zu Kloster Veilsdorf, Kloster Veilsdorf, S. Meiningen, Germany
Societa Ceramica Richard, Sant' Cristoforo, and 21, Via Bigli, Milan
VON PONCET GLASS WORKS, 54, Köpnickerstrasse, Berlin, S.O. 16. **See Advt., p. 740**

IVORY TABLETS, MAKERS OF.

Bailliet, V., 25, Rue Chapon, Paris
Dujardin, G., 84, Rue Brûle-Maison, Lille.

LAMP HOLDERS, MAKERS OF.

Ohl, G. E., Hamburg, Germany
Isolit—Deutschmann, Richard, 95, Königgrätzerstrasse, Berlin
Société (anonyme) Électricité et Hydraulique, Charleroi, Belgium

LAMPS FOR RAILWAYS, &C., MAKERS OF.

NEWBOLD, H., 143, Rue St. Antoine, Paris
Maker of Incandescent Lamps of all patterns, voltages, and intensities

LIGHTNING CONDUCTORS, MAKERS AND CONTRACTORS FOR THE ERECTION OF.

Aktien-Gesellschaft Butzke, 12, Ritterstrasse, Berlin, S.
Aktien-Gesellschaft Mix & Genest, 14A, Neuenburgerstrasse, Berlin, S.W.
Bell Telephone Company of Sweden, Stockholm
Beyerle, L., 3, Greifengasse, Speyer, Germany
Closset, E., 157, Boulevard du Hainaut, Brussels
FELTEN & GUILLEAUME, Carlswerk, Mülheim-on-Rhine, Germany. **See Advt., p. 9**
Herholz, George, 44, Friedenauerstrasse Fridenau, Berlin, W.
Zwarg, J. Otto, Freiberg, Saxony, Germany

LINEMEN'S IMPLEMENTS, MAKERS OF.

KÜCKE (W.) & CO, Elberfeld, Germany. **See Advt., p. 541**

Makers of Engineers' tools, Linemen's tool wallets and boxes, clamps for steel and bronze wire, tackles, vices, soldering tools, pliers, screw-drivers, climbing shoes, telegraph and telephone tools, telegraph pocket knives, etc., etc.

LINEMEN'S TOOL-BOXES AND CHESTS, MAKERS OF.

KÜCKE (W.) & CO., Elberfeld, Germany. **See Advt., p. 541**

LINEMEN'S TOOL-WALLETS, MAKERS OF.

KÜCKE (W.) & CO, Elberfeld, Germany. **See Advt., p. 541**

MACHINERY MERCHANT AND AGENT.

Holwech, Olaf M., Fredrikstad, Norway

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MARINE VOLT AND AMMETERS, MAKERS OF.

MEYER, DR. PAUL, 67, Holzmarktstrasse, Berlin, O. **See Advt., p. 641**

MEASURING INSTRUMENTS (ELECTRIC), MAKERS OF.

Alioth (R.) & Co, 43 and 45, Claragraben, Basle, Switzerland
Aubert, A. J. J., 7, Place St. François, Lausanne, Switzerland
Chabrié & Jean, 52 bis, Rue des Martyrs, Paris
Giltay, J. W., 73, Voorstraat, Delft, Holland
Hartmann & Braun, Bockenheim, Frankfort-on-the-Main
MEYER, DR. PAUL, 67, Holzmarktstrasse, Berlin, O. **See Advt., p. 641**

METAL FOUNDERS AND REFINERS.

Aluminium-Industrie Aktiengesellschaft, Neuhausen (Schaffhouse), Switzerland
Electric Copper Refining Company, Osaka, Japan
Fonderie et Tréfilerie de Bronze Phosphoreux d'Anderlecht, 415, Chaussée de Mons, Anderlecht-lez-Brussels
Heraeus, W. C., Hanau, Germany (Platinum)
Höveler & Dieckhaus, Papenburg, Germany
Maguin, A., 10, Rue Alibert, Paris. (Manganese)
Minner, Wilhelm, The Mines, Arnstadt, Thuringia, Germany. (Manganese)
Oberschlesische Eisen-Industrie (Actien-Gesellschaft für Bergbau und Hüttenbetrieb), Gleiwitz, Germany
Sachsische-Kupfer und Messingwerke (F. A. Lange), Grünthal in Erzgebirge, Saxony. (Copper and Brass)
Société Electro-Metallurgique Française, Froges and Champ (Isère), France. (Aluminium)
Société Française d'Alumine pure, 119bis, Rue Notre Dame des Champs, Paris
Société Française, d'Electro-Metallurgie pour la Fabrication de Cuivre et autres Métaux par les procédés Elmore et Secrétan, 14, Rue de la Pepinnière, Paris; and Dives (Calvados), France
Thonwaaren und Aluminiumfabrik Ludwigshütte, Sprendlingen, Rheinhessen, Germany

METERS (ELECTRIC), MAKERS OF.

Aron—Aron, Prof. Dr. H., 6, Lützowstrasse, Berlin, W.
——— Doerr, E., 200, Quai Jemmapes, Paris
Breguet Maison (soc. anon.), 19, Rue Didot, Paris
Brillié—Compagnie (anon.) Continentale pour la Fabrication des Compteurs à Gaz et autres Appareils (J. Brunt & Co), 9-15, Rue Pétrelle, Paris
Clerk—Postel-Vinay, A., 38, Rue Vaneau, Paris
Hahn Frères and Co, Landeron, Switzerland
Marès—Déjardin, J., 57, Boulevard Richard Lenoir, Paris
MEYER, DR. PAUL, 67, Holzmarktstrasse, Berlin, O. **See Advt., p. 641**
Méplan-Rechniewski—Société de Construction des Piles et des Accumulateurs à Liquide Immobilisé, 98, Rue d'Assas, Paris
Richard Frères, 8, Impasse Fessard, Paris
Siemens & Halske, Markgrafenstrasse, Berlin; St. Petersburg; and Vienna
Soulat, J., Sançoins (Cher), France
Thomson—Compagnie pour la Fabrication des Compteurs et Materiels d'Usines (Soc. anon.), 16-18, Boulevard de Vaugirard, Paris

MICA MERCHANTS.

TANNAHILL (A.) & CO, 21, Mincing-lane, London, E.C.; and at Paris
Mica cut to pattern and thickness for Electrical and other purposes.

MICROPHONES, MAKERS OF.

Actien-Gesellschaft Mix & Genest, 14A, Neuenburgerstrasse, Berlin, S.W.
Berliner, J., 1, Neuestrasse, Hanover, Germany
Carbone, Le, soc. anon. (anc. Lacombe & Cie), 13 and 33, Rue de Lorraine, Levallois-Perret, near Paris
Ericsson (L. M.) & Co, 5, Tulegatan, Stockholm
Journaux, J., 56, Rue des Cévennes, Paris-Grenelle
Peyer, Favarger et Cie, Neuchâtel, Switzerland
Roulez, —, 9, Rue Caumartin, Paris
Wich, J., 83, Rue Chaulot, Paris

MINERS' SAFETY LAMPS, MAKERS OF.

Desroziers, E., 74, Rue Condorcet, Paris
Newbold, H., 143, Rue St. Antonie, Paris
Zipernowsky-Déri-Blathy—Ganz & Co, Budapest, Hungary
——— Schneider & Co, Usines de Creusot (Saône-et-Loire); and 1, Boulevard Malesherbes, Paris

PATENT AGENTS AND EXPERTS.

Bède (E.) & Co, 37, Rue Philippe le Bon, Brussels
Bolibar, Gerónimo, 13, Canuda, Barcelona, Spain
Casalonga, D. A., 11, Rue des Dechargeurs, Paris
Guillery, —, Rue d' Arlon, Brussels
Häberlein (Dr.) & Co, 7, Karlstrasse, Berlin, N.W.
Office for Patents for Industrial Protection and Trade Marks in Italy and Abroad, 2, Via Meravigli, Milan
Pataky, H. & W., 25, Luisenstrasse, Berlin, N.W.; and 7 Heinrichsgasse, Prague, Austria
Pieper, Carl, 3, Hindersinstrasse, Berlin, N.W.
Ritter, A., Basle, Switzerland

PLIERS, MAKERS OF.

KÜCKE (W.) & CO, Elberfeld, Germany. **See Advt., p. 541**

POLE-FINDING PAPER, MAKER OF.

May, Dr. Oscar, 48, Oberweg, Frankfort-on-the-Main

PORTABLE ELECTRIC LAMPS, MAKERS OF.

Newbold, H., 143, Rue St. Antoine, Paris.
Maker of Incandescent Lamps of all patterns, voltages and intensities.

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PUBLICATIONS, ELECTRICAL.

Annales Télégraphiques, 45, Quai des Grands Augustins, Paris

Anzeiger für die Beleuchtungs Industrie und Elektrotechnik, 69, Königsgasse, Budapest

Beiblätter zu Wiedemann's Annalen der Physik und Chemie, Leipzig, Germany. Price M.20 per annum

Biblioteca dell' Elettricità, 5, Via Dante, Milan

Bulletin de l'Association des Ingénieurs Electriciens sortis de l'Institut Electro-Technique Montefiore, 22, Quai Mativa, Liége

Bulletin de la Société Internationale des Electriciens (monthly), 44, Rue de Rennes, Paris

Bulletin de l'Électricité et de la Télégraphie (weekly), 25, Rue Fontaine, Paris. Price 15fr. (=12s.) per annum

Bulletin International de l'Électricité (weekly), 15, Place Vendôme, Paris. Price 10fr. per annum

Chemiker Zeitung (semi-monthly), Cöthen, Anhalt, Germany

Comptes Rendus, Organ of the Paris Academy of Sciences, 55, Quai des Grands-Augustins, Paris. (Price 75 centimes)

Electricien, L', *Revue Internationale de l'Électricité et de ses Applications* (weekly), 3, Rue Racine, Paris. Price 25fr. (=£1) per ann.

Electricista, El (monthly), Pelayo 10, Barcelona, Spain

Electricité (weekly), 31, Boulevard des Italiens, Paris. Price 15fr. per annum

Elektrizität, Die (semi-monthly), Leipzig. (Ann. sub., M.8)

Elektrotechniker, Der (semi-monthly), 23, Victorgasse, Vienna, IV. (Ann. sub. M. 12=12s.)

Elektrotechnische Bibliographie (monthly), 6, Johannisgasse, Leipzig. (Ann. sub., M. 5)

ELEKTROTECHNISCHE ZEITSCHRIFT (weekly), 3, Monbijouplatz, Berlin, N. Annual subscription, £1. 5s. 0d.

Elektrotechnischer Anzeiger (twice weekly), 6, Lützowstrasse, Berlin, S.W. Price 10s. per annum

Elektrotechnisher Rundschau (fortnightly), 10, Kaiserstrasse, Frankfort. Price 6 Marks (=6s.) per half-year

Elektrotechnisches Echo (weekly), 5, Konigstrasse, Leipzig. Price 3 Marks (=3s.) per quarter

Elettricista, L' (monthly), 193, Via Panisperna, Rome. (Ann. sub., 12s.)

Elettricità, L' (weekly), 2, Via Meravigli, Milan. Price 15fr.

Fortschritte der Elektrotechnik (quarterly), 51, Bulowstrasse, Berlin, W.

Industrie, L' (weekly), 13, Rue Ducale, Brussels; and 112, Rue Richelieu, Paris. Ann. sub., P.U., 25fr. (=£1.)

Industrie Electrique, L', (semi-monthly). Editorial offices, 6, Rue de Clichy; publishing offices, 9, Rue de Fleurus, Paris. Ann. sub., P.U., £1.

Subscriptions received by "THE ELECTRICIAN" PRINTING AND PUBLISHING COMPANY, LIMITED, *1, 2 and 3, Salisbury-ct, Fleet-st, London, E.C.*

Industriel du Nord et des Ardennes (semi-monthly), 25, Rue Nicolas-Leblanc, Lille (Nord), 75, Rue Vivienne, Paris; and at Charleville, Ardennes, France. Ann. sub., P.U., 6.50fr.

Intermédiare des Mathematiciens, L' (monthly), 55, Quai des Grands Augustins, Paris

Internationaler Central Anzeiger für die Gesammte Electrotechnik (semi-monthly). Published by Gebrüder Knauer, Frankfort-on-the-Main

Journal des Applications Électriques et Électro-Chemiques, 72, Rue Louis Blanc, Paris. Ann. sub., P.U., 6fr.

Journal Télégraphique (monthly), Berne, Switzerland. Price, Switzerland, 4.40fr.; P.U., 5fr. (=4s.) per annum

Lumière Électrique, La (weekly), 31, Boulevard des Italiens, Paris. Ann. sub., 60fr.

Moniteur Industriel (weekly), 1 and 3, Rue Laffitte, Paris. Annual subscription (U.K.), 40fr.=£1. 12s.

Sciences et Commerce (semi-monthly), 24, Boulevard Poissonnière, Paris. (Ann. sub., P.U., 13 fr.=12s.)

Telegrafista Español, El, (four times a month), 24, Espiritu Santo, Madrid. Price 24 pesetas per annum

Weidemann's Annalen der Physik und Chemie, Leipzig. Price 36 marks per annum

Zeitschrift für Electrotechnik (twice a month), 7, Nibelungengasse, Vienna, I.

Zeitschrift für Physikalische Chemie, 34, Brüderstrasse, Leipzig. Ann. sub., M.5=5s.

PULLEY BLOCKS, MAKERS OF.

KÜCKE (W.) & CO, Elberfeld, Germany. **See Advt., p. 541**

RAILWAY AND TRAMWAY (ELECTRIC) ENGINEERS AND CONTRACTORS.

Deprez, Marcel, 30, Rue des Binelles, Sèvres, France

Desroziers, E., 74, Rue Condorcet, Paris

MASCHINENFABRIK OERLIKON Oerlikon, bei Zürich, Switzerland

Julien, Ed., 101, Rue du Commerce, Brussels.

Siemens & Halske, Markgratenstrasse, Berlin, Vienna and St. Petersburg.

Union Elektricitäts Gesellschaft, 32, Holmannstrasse, Berlin

RAILWAY SIGNALS, MAKERS OF

Bouckaert & Co, 134, Rue Verte, Brussels

Breguet Maison (soc. anon.), 19, Rue Didot, Paris.

Stieberitz, Heinr. (Otto Brunn Nachfolger), 22, Josephinenstrasse, Dresden, A.

Teirich & Leopolder, 47A, Vörösmartyutcza, Budapest VI.; and at Vienna, Leipzig, &c.

REFLECTOR AND SHADE MANUFACTURERS.

Campe & Co. 24, Seydelstrasse, Berlin, C.

Félureau et Cie, 52, Rue Lafayette, Paris.

ROOTHAAN & ALEWIJNSE, 73A, Boulevard de Waterloo, Brussels

SCHOOLS AND COLLEGES.

Collège de France, Rue des Écoles, Paris

École Municipale de Physique et de Chimie Industrielles, 42, Rue Lhomond, Paris

École Nationale d'Electricité et Horlogerie, Brussels

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Elektrotechnisches Institut der k.k. tech. Hochschule, 12, Paniglasse, Vienna IV.
Elektrotechnisches Institut der Konigl. technischen Hochschule, Stuttgart-i.-W., Germany
Elektrotechnische Lehr- und Untersuchungs-Anstalt des Physikalischen Verein, Frankfort-on-the-Main
Institut Electro-Technique Montefiore (for the training of electrical engineers), University of Liège, Liège, Belgium
Technikum Mittweida, Mittweida, Saxony

SECONDARY GENERATORS (*see* Transformers).

SIGNAL VOLT AND AMMETERS, MAKER OF.

MEYER, DR. PAUL, 67, Holzmarktstrasse, Berlin, O. **See Advt., p. 641**

SOCIETIES AND INSTITUTIONS.

Académie Royale des Sciences, Lettres, et Beaux-Arts, 1, Rue Ducale, Brussels
Académie des Sciences, 23, Quai Conti, Paris
Académie des Sciences Industrielles, des Arts et Manufactures, 3 Rue Déchargeurs, Paris
Académie Universalle des Sciences et des Arts Industrielles, 53, Rue d'Angleterre, Brussels
Asociacion de Ingenieros Industriales, Rambla de San José, 30-1°, Barcelona, Spain.
Association des Ingénieurs Electriciens sortis de l'Institut Electro-Technique Montefiore, Liège
Association pour l'Étude de l'Electricité, 1, Rue Appert, Paris
Association Française pour l'Avancement des Sciences, Hotel des Sociétés Savantes, 28, Rue Serpente, Paris
Belgian Royal Commission for Applications of Electricity to Mines, Brussels
Bureau des Longitudes, 23, Quai Conti, Paris
Conservatoire National des Arts et Métiers, 292, Rue St. Martin, Paris
Elektrotechnical Institute, 10, Berggasse, Vienna, IX.
ELEKTROTECHNISHER VEREIN, 40, Artilleriestrasse, Berlin. *For principal Officials, see page 686.*
Elektrotechnisher Verein, Hôtel "Magdeburger Hof," Magdeburg
Elektrotechnischer Verein, 7, Nibelungengasse, Vienna
Hamburger Elektrotechnikverein, Hamburg
Imperial Russian Geographical Society (Gen. Dr. A. de Tillo, President Mathematical Section), St. Petersburg
Leipziger Elektrotechniker-Verein, Brüderstrasse, Leipzig
Physikalischer Verein, 32, Stiftstrasse, Frankfort-on-the-Main
Polytechnischer Verein, Munich
Schweitzerischer Electrotechnischer Verein, Neuchâtel
Società Italiana di Elettricità pel progresso degli Studi e delle Applicazione, Milan
Société Belge d'Electriciens, Place de la Bourse, Brussels
Société Belge des Ingénieurs et des Industriels, Place de la Bourse, Brussels
Société d'Encouragement pour l'Industrie Nationale, 44, Rue des Rennes, Paris
Société d'Études pratiques sur l'Electricité industrielle, Bourse du Commerce, Paris
Société Electrotechnique de Paris, 44, Rue de Rennes, Paris
Société Eletrotechnique de St. Pétersbourg, 24, Millionnaia, St. Petersburg.
Société Française de Physique, 44, Rue de Rennes, Paris
Société des Ingenieurs Civils, 10, Cité Rougement, Paris. (P. Jousselin, President)
SOCIÉTÉ INTERNATIONALE DES ELECTRICIENS, 44, Rue de Rennes, Paris. (*For list of Officials, &c., see p. 686*)
Société Nationale des Sciences et Arts Industriels, 3, Rue des Pyramides, Paris.
Syndicat Professionel des Industries Electriques, 10, Rue de Lancry, Paris
Tokyo Electrical Society, 6, Sanchome Sanjukkenbori, Kyobashiku, Tokyo, Japan

SOLDERING TOOLS, MAKERS OF.

KÜCKE (W.) & CO, Elberfeld, Germany. **See Advt., p. 641.**

STAPLE-DRIVERS, MAKER OF.

Mackley, Carl Thomas, Ueberlingen am Bodensee, Baden, Germany
Mackley's Patent Staple-Driver, for fixing electrical wires to walls, &c.; adopted by all European Telegraph authorities.

SWITCHES, MAKERS OF.

Actien-Gesellschaft Mix and Genest, 14A, Neuenburgerstrasse, Berlin, S.W.
Breguet Maison (soc. anon.), 19, Rue Didot, Paris
MEYER, DR. PAUL, 67, Holztmarktstrasse, Berlin, O. **See Advt., p. 641**
Pabst, Ernst, Hanover
Royal & Star—Allgemeine Electrizitäts-Gesellschaft, 22, Schiffbauerdamm, and 72-76, Ackerstrasse, Berlin, N.

SWITCH BASES, BOARDS AND COVERINGS, MANUFACTURERS OF.

Allgemeine Electrizitäts-Gesellschaft, 22, Schiffbauerdamm, and 72-76, Ackerstr., Berlin, N.
Chauffier, J., Esternay (Marne), France.
MEYER, DR. PAUL, 67, Holztmarktstrasse Berlin, O. **See Advt., p. 641**
Société (anonyme) Electricité et Hydraulique, Charleroi, Belgium

TACKLES FOR CONDUCTING WIRE, MAKERS OF.

KUCKE (W.) & CO, Elberfeld, Germany. **See Advt., p. 541**

TELEGRAPH APPARATUS MAKERS.

Bracke, C., 14, Puttkammerstrasse, Berlin, S.W.
Eriesson (L. M.) & Co, 5, Tulegatan, Stockholm
Fleig, Karl, Villingen, Baden, Germany
Grentz, O., 24, Bleicherweg, Zürich
Köhn, W., 47, Yorkstrasse, Berlin, W.
Kraentzer, Franz, 40, Nostizstrasse, Berlin, S.W.

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KÜCKE (W.) & CO, Elberfeld, Germany. **See Advt., page 541**
Müller & Preussgur, 1, Bergstr., Zittau, Germany
Müller, Louis, Bingen-a. Rh., Germany
Schuchardt, F., 9, Wassergasse, Berlin, S.O.
Seitz & Linhardt, Aschaffenburg, Germany
Siemens & Halske, Berlin, Charlottenburg, Vienna and St. Petersburg
Stock (R.) Co., 29, Waldemarstrasse, Berlin, S.O.
WEILLER (LAZARE) & CIE, 52, Boulevard Malesherbes, Paris. **See Advts., pp. 746, 773 and 775**
Wetzer, H., Pfronten, Bavaria

TELEGRAPH AND CABLE COMPANIES.

Compagnie Française du Télégraphe de Paris à New York, 53 bis, Rue de Chateaudun, Paris; and at Brest, and Havre
GREAT NORTHERN TELEGRAPH COMPANY OF COPENHAGEN, 28, Kongens Nytorv, Copenhagen

TELEGRAPH CABLES, MAKERS OF.

SOCIETE D'EXPLOITATION DES CABLES ELECTRIQUES (système Berthoud-Borel et Cie), Cortaillod, Switzerland. **See Advt., p. 8**
STUTTGARTER TELEGRAPHENDRAHT-FABRIK (A. KREIDLER), Stuttgart **See Advt., p. 36**
WEILLER (LAZAIRE) et CIE, 52, Boulevard Malesherbes, Paris. **See Advts. pp. 746, 773 and 775**

TELEGRAPHS, CONTRACTORS FOR.

Biedermann, F., 43, Nürnbergerstr., Berlin, W.
Buss, Sombart & Co, Magdeburg, Germany
FELTEN & GUILLEAUME, Carlswerk, Mülheim-on-Rhine, Germany. (London Agents, W. F. Dennis and Co, 11, Billiter-st, London, E.C. **See Advt., p. 9**
Hammacher & Paetzold, 32, Andreastrasse, Berlin, O.
Hanover Caoutchouc, Gutta Percha and Telegraph Works, Linden, near Hanover
Lewert, C. F., 11, Louisen-Ufer, Berlin, S.
Pirelli & Co, Telegraph Works, Milan and Spezia
Richter, R., 56, Zimmerstrasse, Berlin, S.W.
Siedle (S.) & Söhne, Furtwangen, Baden, Germany
Siemens & Halske, Markgrafenstrasse, Berlin; Charlottenburg, Vienna, and St. Petersburg.
SOCIÉTÉ D'EXPLOITATION DES CABLES ELECTRIQUES, Cortaillod, Switzerland. **See Advt., p. 8**
Spohr, H. C., 37, Gr. Friedbergerstrasse, Frankfort-on-the-Main
WEILLER (LAZARE) et CIE, 52, Boulevard Malesherbes, Paris. **See Advts., pp. 746, 773 and 775**

TELEGRAPH ENGINEERS.

(Telegraph Superintendents, Managers, and Inspectors will be found on page 624)

Agémian, Mighirditch, Turkish Posts and Telegraphs, Constantinople
Andrews, F. P. W., Anglo-American Telegraph Company, Brest, France
Baboulet, G. Louis M., Besançon (Doubs), France
Banneux, J., Belgian State Telegraph Department, Hôtel Central, Brussels
Bieringer, E., Bavarian Telegraph Service, Munich
Binet, L., Chemin de Fer de l'Ouest, 7, Villa des Couronnes, Asnières (Seine), France
Blackwood-Price, Hy. N., 1, Via Fabio Severo, Trieste, Austria
Bolton, F., Eastern Telegraph Company, 12, Via Carintia, Trieste, Austria
Brix, Dr. Philipp W., Imperial Telegraphs, 13 and 14, Berlinerstrasse, Charlottenburg, Berlin
Browne, H. V., Direct Spanish Telegraph Company, Barcelona, Spain
Collard, Capt., Antwerp, Belgium
Collette, J. M., Netherlands Telegraphs, The Hague
Cour, Paul la, Askovhus, Vejen Station, Denmark
Docteur, —, Chemins de Fer, Postes et Telegraphes, Brussels
Dresing, P. Chr., Great Northern Telegraph Company, Copenhagen
Eschbaechker, —, Secretary of the International Telegraph Bureau, Berne
Fargues, John, Telegraph Department, Teheran, Persia
Fribourg, G., 132, Boulevard Saint Germain, Paris. (Inspector-General of Posts and Telegraphs)
Graves, E., Indo-European Government Telegraphs, Ispahan, Persia
Gurlt, W., 24, Friedrichstrasse, Berlin, S.W.
Hansen, Carl V., Horsens, Denmark
Hoskjor, Col. V., Royal Danish Engineers, Copenhagen
Jacquez, Ernest, 54, Avenue de Breteuil, Paris
Jaite, Gustave, Imperial Posts and Telegraphs, Berlin
Khoury, M., Egyptian Telegraphs, Port Said, Egypt
Marguerittes, M. de, Posts and Telegraphs, Paris
MunGavin, George W., Indo-European Telegraph Company, Persian Gulf
Reisser, Wilh., 13a, Wilhelmsplatz, Stuttgart
Seligmann-Lui, G. P., 6, Rue Daubigny, Paris
Stephan, Dr. H. von, Posts and Telegraphs, Berlin (Secretary of State)
Suarez-Saavedra, Antonino, Bilbao
Tietgen, C. F., Privatbanken, Copenhagen
Touanne, — de la, 13, Rue Soufflot, Paris
Trotin, E., 38, Quai Henri IV., Paris
Tsuboi, M., M.E., Ministry of Communications, Tokyo, Japan
Waffelaert, Major, Compagnie des Télégraphistes, 70, Rue du Cornet, Brussels
Malesherbes, Paris. **See Advts., pp. 746, 773 and 775**
WEILLER (LAZARE) & CO, 52, Boulevard
Weissenbruch, L., Engineer to the Minister of Posts and Telegraphs, 45, Rue du Poingon, Brussels
Yonge, M. de, Boleleng, Bally, Netherlands India
Zetzsche, Dr. Carl Eduard, 8, Carlstrasse, Dresden, II., Saxony. (Consulting)

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TELEGRAPH (&c.) SUPERINTENDENTS, MANAGERS, AND INSPECTORS (COVERNMENT AND COMPANIES').

Anderson, James, Eastern Telegraph Company, Syra, Greece. (Divisional Manager)
Aparicio, José, Direct Spanish Telegraph Company, 2, Plaza de las Salesas, Madrid (Representative)
Avantinos, Demosthènes, Greek Posts and Telegraphs, Athens. (Director General)
Badoux, 73, Rue Makoy, Liège
Banchi, H., Eastern Extension, Australasia and China Telegraph Company, Medan
Baudot, Emile, 6, Rue Mayet, Paris. (Inspecting Engineer of Telegraphs)
Baume, —, Direction Générale des Postes et des Telegraphes, Besançon (Doubs), France (Inspector)
Berman, J., Java Government Telegraphs, Java (Inspector)
Bolton, F., Eastern Telegraph Company, Trieste
Bonnard, F., West African Telegraph Company, Kotonou, West Africa
Bratt, Hugo, Stockholm, Sweden (Director of State Telegraphs)
Broughton, R. A., Brazilian Submarine Telegraph Company, Lisbon
Bullard, W., Eastern Extension Telegraph Company, Shanghai (Controller)
Cabral, P. B., Inspector-General of Telegraphs, Rua da Quintinha 108, Lisbon
Carabott, G., African Direct Telegraph Company, Lagos, West Africa
Chesney, Major H. F., R.E., Indo-European Telegraph Department, Teheran (Assistant-Director)
Cole, C. J., Eastern Extension Telegraph Company, Macao, China
Collier, J. C., Eastern Extension, Australasia and China Telegraph Company, Batavia
Collis, W. J. P., Eastern Extension Australasia and China Telegraph Company, Cape St. James, Saigon
Cottrell, W. H., Eastern Telegraph Company, Syra, Greece
Coxen, J. U., Eastern Telegraph Company, Suakim, Egypt
Despecher, Jules, Eastern Telegraph Company, 12, Rue Caumartin, Paris (Agent)
Eggington, A., Eastern Telegraph Company, 28, Via Venti Settembre, Rome, Italy. (Agent)
Establet, B., West African Telegraph Company, Gaboon
Evrard, F., Belgian States Telegraphs, Brussels (Director)
Fehr, Konrad, Swiss Telegraphs, Berne, Switzerland (Director-General)
Feytens, P. F., Direct Spanish Telegraph Company, Hotel des Postes et Telegraphes, Rue St. Cannat, Marseilles, France
Forster, W. G., Eastern Telegraph Company, Zante
Giles, E. A., Eastern and South African Telegraph Company, Zanzibar
Gillespy, W., Eastern Telegraph Company, Alexandria, Egypt
Griffin, Thomas, Eastern Telegraph Company, Tangier, Morocco
Gulliford, J. M., Eastern and South African Telegraph Company, Lourenço Marques, Delagoa Bay
Harwood, F. S., Eastern Telegraph Company, Carcavellos, Lisbon
Hekimian, V., Black Sea Telegraph Company, Pera, Constantinople
Henningsen, J., Great Northern Telegraph Company, Shanghai, China (Manager in China and Japan)
Hoencke, H., Lieut.-Col., Danish Telegraphs Copenhagen, Denmark. Head Director and Superintendent)
Howard, A. C., Manager Orange Free State Telegraphs, South Africa
Husson, Léon, Eastern Extension Australasia ann China Telegraph Company, Haiphong, China
Jones, H. W., Eastern Extension Australasia and China Telegraph Company, Cape Bolinao, Manila, Philippine Islands
Jullien, A., West African Telegraph Company, Conakry
Kitching, R., West African Telegraph Company, Bolama
Kolvig, F., Great Northern Telegraph Company, 103, Rue de Grenelle, Paris
Kragh, C. H., Great Northern Telegraph Company, Nagasaki, Japan
Kursch, C. V., Great Northern Telegraph Company, Libau
Landgren, A., Imperial Russian State Telegraphs, St. Mariehamn, Russia
Lawson, E. G., Brazilian Submarine Telegraph Company, Madeira
Lawton, G. F., 2, Boulevard du Muy, Marseilles
Le Cöat, Elie, Eastern Telegraph Company, Bona, Algeria
Leighton, D.W., Eastern Telegraph Company, Chios
Lloyd, Edwin L., Brazilian Submarine Telegraph Company, Cape de Verde
Meurling, L. A., Swedish State Railways, Stockholm
Monares, Rafael, Madrid (Director-General)
Montillot, P. L., 75, Avenue de la Republique, Montrouge (Seine), France
Noblet, L., Compagnie des Chemins de fer de l'Ouest, 36, Rue du Bac, Asnières (Siene), France
Pallisen, H. J., Black Sea Telegraph Company, St. Petersburg, Russia (Agent)
Parkinson, J. A., Eastern Telegraph Company, Cadiz, Spain
Paulsen, E. A., Great Northern Telegraph Company, Mariehamn (Controller and Assistant Electrician)
Payn, J. J., Eastern Telegraph Company, Cairo
Pownall, C. H., Eastern Extension Australasia and China Telegraph Company, Banjoewangie, Java
Prosser, A. W., Eastern Telegraph Company, Odessa
Quintana, J., Eastern Telegraph Company, Canea
Rasmussen, A. C. M., Government Telegraphs, Christiania (Director-General)
Rentzsch, Fred. John, Eastern Extension Australasia and China Telegraph Company, Foochow, China

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Rogerson, W., Eastern and South African Telegraph Company, Benguella, West Coast of Africa
Roggeri, L., Eastern Telegraph Company, Port Said
Rose, J. R., Eastern Telegraph Company, Vigo, Spain
Rothen, Dr. T., Directeur du Bureau Internationale des Administrations Télégraphiques, Berne, Switzerland
Ryan, A. M., Eastern and South African Telegraph Company, Mozambique
Sabater, Salvador, Eastern Telegraph Company, B², Calle de las Minas, Madrid (Agent)
Saffery, A. H., African Direct Telegraph Company, St. Iago, Cape Verde Islands
Santos, Carlos, Eastern Telegraph Company, 120, Rua dos Capellistas, Lisbon (Agent)
Sartiaux, E., Telegraph Service, Chemin de fer du Nord, Paris
Scarlett, E., Eastern and South African Telegraph Company, Mossamedes, West Africa
Scovell, George R., West African Telegraph Company, Principe, West Coast of Africa
Smith, Benjamin, Eastern Telegraph Company, Alexandria. (Manager in Egypt)
Smith, J. R., West African Telegraph Company, Loanda
Suenson, Comm. E., D.N.R., Managing Director Great Northern Telegraph Company, Copenhagen
Tait, P., Eastern and South African Telegraph Company, Zanzibar
Triantafilly, P. S., Eastern Telegraph Company, Athens
Trotsenburg, C. K. van, Telegraphs and Telephones of South African Republic, Pretoria. (Manager)
Tuck, William, Eastern Telegraph Company, Suez, Egypt
Warren, Amos, Ottoman Railway, Smyrna
Wennström, O., Mariehamm (Inspector)
Zobel, G. A., Eastern Telegraph Company, Tripoli

TELEGRAPH AND TELEPHONE TOOLS, MAKERS OF.

KÜCKE (W.) & CO, Elberfeld, Germany. **See Advt., p. 541**

TELEGRAPH WIRES, MAKERS OF.

(*See also* **Wire Manufacturers.**)

Huber, E. R., Pfäffikon, Zürich
Levi (M.) & Co, Naples
Mannheimer Telegraphendraht & Kabelfabrik (C. Schacherer), Mannheim
Osnabrücker Kupfer & Drahtwerke, Osnabrüch, Germany
Roth, Heck & Schwinn, Ixheim bei Zweibrücken, Germany
SOCIETE D'EXPLOITATION DES CABLES ELECTRIQUES (Système Berthoud-Borel, Cortaillod, Switzerland. **See Advt., p. 8**
Société des Forges St. Hippolyte (Doubs), France
Société Française de Caoutchouc, Amiantes et Câbles (Martiny, Limited), St. Denis, France
STUTTGARTER TELEGRAPHENDRAHT-FABRIK (A. KREIDLER), Stuttgart. **See Advt., p. 36.**

LAZARE WEILLER,
Telephonic and Telegraphic Engineer,
CONSTRUCTOR & CONTRACTOR
OF
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ELECTRIC LINES.
Manufacturer of all sorts of Improved
ELECTRICAL WIRES.
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Mills at Angoulême (Charente).
SOLE AGENCY AND DEPÔT
(for Great Britain and the Colonies):
FERNAND ESPIR,
3, East India Avenue, London, E.C.

TELEPHONE APPARATUS (MAKERS OF). (*See* Electrical Apparatus Makers.)

TELEPHONE COMPANIES.

Bell Telephone Company of Sweden, Limited, Stockholm
China and Japan Telephone Company, Limited, Shanghai, China
Christiania Telefonselskab, Christiania, Norway
Compagnie du Home Téléphone, 9, Avenue de l'Opéra, Paris
Compagnie du Théâtrophone, 23, Rue Louis-le-Grande, Paris
Compagnie Belge du Téléphone Bell (société anonyme), Antwerp, Charleroi, Ghent, &c.
Compagnie Liégeoise du Téléphone Bell (société anonyme) Liège, Belgium
Fredriksstad Telephone Company, Fredriksstad, Norway. (Olaf M. Holwech, Manager)
Telephone Company of Egypt, Alexandria, &c. (*See also* BRITISH DIVISION)
Wiener Privat-Telegrafen-Gesellschaft, 15, Helferstorstrasse, Vienna

TELEPHONE ENGINEERS.

Bergh, Georg, Helsingfors, Finland, Russia
Berthon, A., Manager of the Société Industrielle des Téléphones, 51, Rue de la Chaussée d'Antin, Paris
Cedergren, —, Société Industrielle des Téléphones, Stockholm
Cornet, L., 33, Rue Rudolph, Antwerp, Belgium
Danvers, Alan, 66, Travéssa da Sta. Justa, Lisbon
Evans, W. N., Manager (in Egypt), of the Telephone Company of Egypt, Alexandria, Egypt
Henry, Paul, 16, Rue Réaumad, Paris
Henry, René, 207, Rue du Faubourg St. Martin, Paris
Holwech, Olaf M., Fredriksstad, Norway
Macklay, Carl Thomas, Ueberlingen am Bodensee, Baden, Germany
Maiche (L.) & Co, 45, Rue Jacob, Paris
Marchegay, Alphonse, 11, Quai des Celestins, Lyon (Rhône), France

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Mildé (Ch.) Fils et Cie, 26, Rue Laugier, Paris
Stevenson, G. C., Telephone Company of Egypt, Limited, Alexandria
Tsuchiya, E., Kobe Telephone Exchange Office, Kobe, Japan
Vanoni, L., Manager of the Geneva Telephone Service, 13, Rue de Candolle, Geneva
WEILLER (LAZARE) & CO, 52, Boulevard Malesherbes, Paris. **See Advt., pp. 746, 773, and 775**
Welles, F. R., 1, Engel-Ufer Berlin, S.O.

TELEPHONES, CONTRACTORS FOR THE ERECTION OF.

Actien-Gesellschaft Mix and Genest Telephone, 14A, Neuenburgerstrasse, Berlin, S.W., and Hamburg. (*See also* BRITISH DIVISION)
Adler (H. W.) & Co, 34-36, Rothennhofgasse, Vienna, IV.
Berliner, J., Hanover, Germany
Breguet Maison (soc. anon.), 19, Rue Didot, Paris
Compagnie Internationale des Téléphones, 15, Place Vendôme, Paris; and 24, Rue des Douze Apôtres, Brussels
Friedlaender, (Albert) & Co. 115 & 132, Leipzigerstrasse, Berlin, W.
Home—Avril, L. C., 5, Quai Valmy, Paris
International Bell Telephone Company of New York, Limited, Antwerp
Journaux, J., 56, Rue des Cévennes, Paris-Grenelle
Keiser & Schmidt, 20, Johannisst., Berlin, N.
L'Hoest, Félix, 3, Place St. Paul, Liège, Belgium
Oettel, Hermann, 31, Schmidtstrasse, Berlin, S.O.
Netherlands Bell Telephone Company, Damstraat, Amsterdam, Holland
Roulez, —, 9, Rue Caumartin, Paris
Societa anonima Co-operativa di Telefoni, 149, Via Nazionale, Rome
Société des Téléphones de Madrid, 15, Place Vendôme, Paris; and Calle Mayor, Madrid
Société Industrielle des Téléphones, 41, Rue Caumartin, 4, Rue d'Aboukir, 2, Rue des Entrepreneurs, and 7, Rue du Theatre, Paris, and (Submarine Cable Factory) Calais
Société Téléphonique Domestique (Système J. Cerpaux), Brussels
Sonnette—Morlé, E., 54, Avenue Herbillon, Saint-Mandé (Seine), France
WEILLER (LAZARE) ET CIE, 52, Boulevard Malesherbes, Paris. **See Advts., pp. 746, 773, and 775**
Zürcher Telephongesellschaft für Elektrotechnik, Zürich (Aussersihl), Switzerland

TELPHERAGE LINES, CONTRACTORS FOR THE ERECTION OF.

Desroziers, E., 74, Rue Condorcet, Paris

TOOL MAKERS.

Gesellschaft des Echten Naxos-Schmirgals, "Naxos-Union," 43, Waldschmidtstrasse, Frankfort-on-the-Main; and at Vienna
Loewe (Ludw.), Aktien-Gesellschaft, 32, Hollmannstrasse, Berlin, S.W.
KÜCKE (W.) & CO, Elberfeld, Germany. **See Advt., p. 541**

TOOL WALLETS, MAKERS OF.

KÜCKE (W.) & CO, Elberfeld, Germany. **See Advt., p. 541**

TRAMCAR ENGINES (ELECTRIC), MAKERS OF.

MASCHINENFABRIK OERLIKON, Oerlikon bei Zürich, Switzerland

TRANSFORMERS, MAKERS OF.

Deckert—Wich, J., 83, Rue Charlot, Paris
Desroziers, E., 74, Rue Condorcet, Paris
Helios Company, Ehrenfeld, near Cologne, Germany
MASCHINENFABRIK OERLIKON, Oerlikon bei Zürich, Switzerland
Patin—Patin (O.) & Co, 11, Rue Théophile Gautier, Paris
Zipernowski-Déri-Blathy—Ganz & Co, Budapest, Hungary
————Schneider & Co, Usines de Creusot (Saône-et-Loire), France

TRANSLATORS, TECHNICAL.

ROUX, GASTON, 27, Rue de Londres, Paris (English to French)

TURBINE MAKERS.

Briegleb, Hanson & Co, Gothenburg, Sweden
Duvillard, —, Vallon, Lausanne, Switzerland
Faesch & Piccard, 1, Rue de Malagnou, Geneva
Feray & Cie, Essonnes (Seine; and 74, Rue Turbigo, Paris
Fontaine Girard—Brault, Teisset and Gillet, 44, Rue du Ranelagh, Paris, and at Chartres (Eure-et-Loire), France
Hercules—Singrun Frères, Epinal (Vosges) France
Voith, F. M., Heidenheim, Germany

VOLTMETERS, MAKERS OF.

Carpentier, J., 20, Rue Delambre, Paris
Chauvin—Braunschweig, Emil, 4, Friedensstrasse, Frankfort-on-the-Main, Germany
Compagnie Internationale d'Electricité, Rue des Bayards, Liège, Belgium
Dolivo—Allgemeine Elektricitäts Gesellschaft, 22, Schiffbauerdamm, and 72 76, Ackerstrasse, Berlin, N.
Elektrizitäts Aktien-Gesellschaft vormals Schuckert & Co, Nürnberg, Germany
Hartmann & Braun, Bockenheim, near Frankfort-on-the-Main
Kummer (O. L.) & Co, Niedersedlitz, bei Dresden, Germany
MEYER, DR. PAUL, 67, Holzmarktstrasse, Berlin, O. **See Advt., p. 641**
Richard Frères, 8, Impasse Fessard, Paris
Siemens & Halske, Markgrafenstrasse, Berlin; Charlottenburg, Vienna, and St. Petersburg
Weston—Mohr, E., 154, Kopnickerstrasse, Berlin

WIRE COVERERS.

SOCIÉTÉ D'EXPLOITATION DES CABLES ÉLECTRIQUES (Système Berthoud-Borel), Cortaillod, Switzerland. **See Advt., p. 8**

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WIRE DRAWERS.

Duplessy & Hinque, 220, Rue St. Martin, Paris
FELTEN & GUILLEAUME, Carlswerk, Mülheim-on-Rhine, Germany. **See Advt., p. 9**
Hirschmann, Siegfried, 72, Landsbergerstrasse, Berlin, N.O.
SOCIETE D'EXPLOITATION DES CABLES ELECTRIQUES (Système Berthoud-Borel) Cortaillod, Switzerland. **See Advt., p. 8**

WIRE MANUFACTURERS.

Aix-la-Chapelle Iron and Steel Company Rothe Erde, near Aix-la-Chapelle, Prussia.
Bass & Selve, Electric Light Wire Makers Altena, Westphalia
Berg, Carl, Eveking, Westphalia
Compagnie Française du Bi-Métal, 9, Rue Dieu, Paris
Demuth Gebrüder, 67, Kaiserstrasse, Vienna, VII.
Desmoutis, Lemaire et Cie, 56, Rue Montmartre, Paris
Deutsche Phosphorbronce-Industrie (E. V. Münstermann), Ludwigshütte, bei Kattowitz-o/S., Germany
FELTEN & GUILLEAUME, Carlswerk, Mülheim-on-Rhine, Germany. (Iron and Steel Wires, Insulated and Uninsulated, for Electric Lighting, Telephonic, and Telegraphic Purposes.) (W. F. Dennis & Co, 11, Billiter-st, London, England, Sole Agents.) **See Advt. p. 9**
Ferrie & Cie, 11, Rue Rhumkorff, Paris
Fonderies et Laminoirs de Biache-Saint-Vaast (soc. anon.), 28, Rue St. Paul, Paris
Fonderie et Tréfilerie de Bronze Phosphoreux d'Anderlecht, 415, Chaussée de Mons, Anderlecht-lez-Brussels. (Phosphor Bronze Telephone and Telegraph Wire.)
Fuchs, J. W., Nuremburg
Gindre, Duchavany & Cie, 18, Quai de Retz, Lyons
Harnischmacher, B., Heddernheim, bei Frankfort-on-the-Main, Germany
Hen (Léon) & Co, 10, Rue Stéphenson, Brussels-Schaerbeck
Hirschmann, Siegfried, 72, Landsbergerstrasse, Berlin, N.O.
Jacottet & Co, 57, Hauptstrasse, Vienna. IX.; and Simmering and Budapest
Jarriant, A. M., jeune, 75 & 77, Boulevard Gouvion St. Cyr, Paris
Kabelfabrik Landsberg-a.-W., Landsberg-a-W., Germany
Koch, J. C., Hohenlimburg, Germany
Lachmann, Norbert, 65, Blumenstr., Berlin, S.O.
Lange, F. A., 5, Westbahnstrasse, Vienna VII.
Lesjöfors Aktie-Bolags-Upplag, 12, Stora Wattugatan, Stockholm, Sweden
Lyneu-Isaac, L, Stolberg, Rheinland, Germany
Mouchel, J. O., 10, Rue Commines, Paris
Neujean, A. E. Delaite, 50, Rue Hors Chateau, Liège, Belgium
Obach, Th., 3, Paulusgasse, Vienna, III.
Obermaier, J., Nuremburg, Germany. (Telegraph, Telephone and Electric Light Wires)
Perci & Schacherer, 21, Szigony-Utcza, Budapest, VIII. Hungary. (Telegraph Wire)
Pirelli & Co, Telegraph Works, Milan; and Spezia
Rentzsch (H.) & Co, Cöln-Meissen, Germany
SOCIÉTÉ D'EXPLOITATION DES CABLES ELECTRIQUES (Système Berthoud-Borel), Cortaillod, Switzerland **See Advt., p. 8**
Société du Cable Fortin-Hermann, 135, Boulevard du Montparnasse, Paris
Société (anonyme) du Metal Delta et des Alliages Métalliques, 56, Rue de la Victoire, Paris
STUTTGARTER TELEGRAPHENDRAHT-FABRIK (A. KREIDLER), Stuttgart **See Advt p. 36**
Tobisch, Gustav, 31, Bréitenseerstrasse, Vienna, XVI.
Vereinigte Fabriken Englischer Sicherheitzünder, Meissen, Germany
Vogel, J. C., 39, Ritterstrasse, Berlin, S.W.
Westfalische Draht-Industrie, Hamm i. W., Germany

LAZARE WEILLER,
Telephonic and Telegraphic Engineer,
CONSTRUCTOR & CONTRACTOR
OF
OVERHEAD and UNDERGROUND
ELECTRIC LINES.
Manufacturer of all sorts of Improved
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Mills at Angoulême (Charente).
SOLE AGENCY AND DEPÔT
(for Great Britain and the Colonies):
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3, East India Avenue, London, E.C.

WOOD WORKING MACHINES.

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In 1884 the American Institute of Electrical Engineers was organised in New York City, with the following purpose, as stated in the rules:—

"The objects of the American Institute of Electrical Engineers are to promote the Arts and Sciences connected with the production and utilization of Electricity, and the welfare of those employed in these industries; by means of meetings for social intercourse, the reading and discussion of professional papers, and the circulation, by means of publications among its Members and Associates, of the information thus obtained."

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"THE ELECTRICIAN"
ELECTRICAL TRADES' DIRECTORY.

AMERICAN DIVISION.

ALPHABETICAL SECTION.

NOTES.—*Telegraphic and Cable Addresses and Telephone Numbers are shown in italics. In order to render* "THE ELECTRICIAN" ELECTRICAL TRADES' DIRECTORY AND HANDBOOK *as complete and serviceable as possible, the Editors will be glad to receive during 1894 Changes of Address, Names and Addresses not included in the present Edition, newly-registered Telegraphic and Cable Addresses and Telephone Numbers.* No charge is made for inserting these particulars.

An asterisk (*) *prefixed to a name indicates that a* BIOGRAPHICAL SKETCH *appears at the end of the book.*

Advertisers *in* THE DIRECTORY *will find* **prominent reference** *made to their Advertisements and to the pages in which they occur.*

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Abatis Electric Manufacturing Company, Manufacturers of Electrical Apparatus, 65, Lees-bldg, 149, Fifth-avenue, Chicago, Ill. (C. E. Lee Manager)

Abendroth and Root Manufacturing Company Manufacturers of Electric Light Plant, Boilers &c., 28, Cliff-st, New York. (*Dogpalace New York, 1606 Cortlandt*)

Accumulator and Motor Company, Storage Battery Manufacturers, New Brighton, N.Y.

Accumulator Company, Manufacturers of Storage Batteries, 224, Chestnut-st, Philadelphia, Pa.

Acheson, E. G., Electrician and Electrical Engineer, Carborundum Company, Monongahela City, Pa.

Acme Specialty Company, Manufacturers of Electrical and Automatic Appliances, 78, Cortlandt-st, New York

Acme Storage Battery and Manufacturing Company, Manufacturers of the "Kennedy" Storage Batteries, 29, Broadway, New York; and Fuller-bldg, Jersey City, N.J.

Adams Electric Company, Manufacturing Electrical Engineers, 100, Beacon-st, Worcester Mass.

Adams (Frank) Electric Company, Electric Light Engineers and Contractors, 807, Market-st, St. Louis, Mo.

Advance Electric Company, Makers of the Ward and Sloane Battery, 348, Congress-st, Boston, Mass.

Ahlstrom, Oscar G., Electrical Instrument Maker, 162, William-st, New York

Akron Electrical Manufacturing Company, Manufacturers of Electrical Apparatus, Akron, O.

Albro-Glem Elevator Company, Limited, Manufacturers of Electric Cranes and Elevators, 411 and 413, Cherry-st, Philadelphia, Pa.

Aldrich, William S., Electrical Engineer, P. O. Box, 256, Morgantown, W. Va.

Alexander-Chamberlain Electric Company, Consulting Electrical Engineers, Aldrich-court, 45, Broadway, New York

Alexander, Harry, Electrical Engineer, 126, Liberty-st, and 340, West 145th-st, New York

Alexander, P. H., Electrical Engineer, 808, Equitable-bldg., Baltimore, Md.

Allen Electric and Supply Company, Electric Traction Engineers, 232–234, Carter-st, Philadelphia, Pa.

Allen (Gerard B.) & Co, Manufacturers of Electric Power Plants, Fulton Iron Works, cor. Second and Carr-sts. St. Louis, Mo.

Allen, William R., Electrical Engineer and Contractor, 225, Dearborn-st, Chicago, Ill.

Allen-Maxwell Manufacturing Company, Manufacturers of Electrical Apparatus, Chicago

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Allen-Hussey Company. General Electricians and Contractors, 225, Dearborn-st, Chicago, Ill.

Allen (Orla. D.) & Co, Manufacturing Electricians, 32, East High-st, Detroit, Mich.

Allis (Edward P.) Company, Makers of the "Reynolds" Corliss Engine, &c., Reliance Works, Milwaukee, Wis.

Almon, G. H., Electrical Engineer, 136, Liberty-st, New York

Aloe (A. S.) & Co, Manufacturers of Electrical Instruments, 425, North Broadway, St. Louis, Mo.

Altenberg, G. P, Electrical Engineer, 65, Smith-bldg, Cincinnati, O.

Aluminium Battery, Electric Light and Power Co, Electric Light Engineers and Contractors, 78 and 80, Cortlandt-st, New York

Aluminium Brass and Bronze Company, Makers of Silicon-Bronze Wire and all kinds of Electrical Conductors, Bridgeport, Conn.; and 55, Fulton-st, New York

American Battery Company, Manufacturers of the Morrison-Planté and American Batteries, Dynamos, &c., 709, Security-bldg, 188, Madison-st, Chicago, Ill. *(3620)*

American Bell Telephone Company, Telephone-bldg, 95, Milk-st, Boston, Mass.

American Circular Loom Company, Manufacturers of Insulated Wires and Cables, 620, Atlantic-avenue, Boston, Mass.

American Electric Company, Manufacturers of Electrical Apparatus, 102, Pearl-st, Boston, Mass.

American Electric and Manufacturing Company, Electrical and Telephone Engineers and Apparatus Makers, Washington, D.C.

American Electric Elevator Company, Manufacturers of Electric Elevators, 44, Broadway, New York

American Electric Heating Corporation, Manufacturers of Electric Heating Apparatus, 274, Purchase-st, Boston, Mass.

American Electric Motor Company, Makers of Electric Motors, 115, Broadway, New York

American Electric Supply Company, Manufacturers of Electric Supplies, 226, Pearl-st, Buffalo, N.Y. *(1280)*

American Electrical Appliance Company, Dealers in Electrical Apparatus, 39, Dey-st, New York

American Electrical Arc Light Company, Manufacturers of Electrical Apparatus, 71, Broadway, New York; and at New Haven, Conn.

American Electrical Manufacturing Company, Manufacturers of Electrical Machinery and Supplies, and Arc and "American" Incandescent Lamps, 2011–2017, Pine-st, St. Louis, Mo.

American Electrical Works, Makers of Bare and Insulated Wires and Faraday Cables, Providence, Rhode Island, and 10, Cortlandt-st, New York

American Electro-Enamelite Company, Makers of Rheostats and Electric Cooking Apparatus, 333, The Rookery, Chicago, Ill. (Geo. Cutter, General Manager)

American Engine Company, Makers of High-speed Electric Light Engines, 36, Raritan-avenue, Bound Brook, N.J.

American Engineer and Railroad Journal (monthly), 47, Cedar-st (P. O. Box 1515), New York. (Price $3 per annum.) (M. N. Forney, Editor and Proprietor; F. Hobart, Associate Editor)

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 12, West Thirty-first-street, New York. *(For List of Officers, see p. 776)*

American Institute of Mining Engineers, 13, Burling Slip, and P.O. Box 223, New York (Secretary, R. W. Raymond.) *(Time New York, 1485 Cortlandt)*

American Journal of Science and Arts (monthly), New Haven, Conn. (Ann. sub., $6.40 =26s. 6d.)

American Lighting Protection Company, Makers of Hodge's Lightning Conductor, 874, Broadway, New York

American Manufacturing and Engineering Company, Dealers in Electrical Supplies, 143, Liberty-st, New York

American Motor and Dynamo Company, Dynamo and Motor Manufacturers, Denver, Colo.

American Railroad Improvement Company, Electric Traction Engineers, 95, Milk-st. Boston, Mass.

American Standard Battery Company, Storage Battery Manufacturers. 66½, Pine-st, New York

American Society of Civil Engineers, 127, East Twenty-third-st, New York

American Universal Electric Company, Makers of the Standard Fan Motor and Battery, 26, Whitehall-st (Factory): and 140, Washington-st, New York

Ames, Ebert & Co, Dealers in Electrical Supplies, St. Paul, Minn.

Anderson, A. & J. M., Manufacturers of Insulating Materials, 21, Hamilton-st, Boston, Mass.

Anderson, Homer, Maker of Magnet Winders and Electrical Supplies, South-st, Peekskill, N.Y.

Anderson, J., jun., Electrical Engineer, Fabrica del Gas, Montevideo

Andrews & Johnson, Manufacturers of Electrical Apparatus, 46 and 48, South Canal-st, Chicago, Ill.

Angier (G. M.) & Co, Electrical Engineers and Agents, 116, Bedford-st, Boston, Mass.

Angier & Kennard, Dealers in Electrical Supplies, 219, Monadnock-bldg, Chicago, Ill.

Anglo-American Electric Light Manufacturing Company, Electrical Engineers and Makers and Owners of the Sorley Storage Battery, Times-bldg, New York

Anglo-American Electrical Manufacturing Company, Manufacturers of Electrical Apparatus, 136, Liberty-st, New York

ANGLO-AMERICAN TELEGRAPH COMPANY, Limited, 8, Broad-st, 16, Beaver-st, 446, Broome-st, and Stock Exchange, New York. *(2431 and 3711 Cortlandt, 691 Spring)* *(See also* BRITISH DIVISION) **See Advt., p. cxxvii.**

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Anglo-American Union, Limited, Manufacturers of Telephones and Telephonic Apparatus, 136, Liberty-st. New York

Ansonia Electric Company, Manufacturers of Electrical Apparatus, Randolph-st and Michigan-av, Chicago, Ill. Factories: Ansonia, Conn.

Anthony, E. & H. T., Manufacturers of Electrical Apparatus, 591, Broadway, New York

Anthony, Prof. W. A., Consulting Electrical Engineer, Vineland, N.J.

Anthony, Watson G., Electrician, 32½, Webster-st, Newark, N.J.

Appleton, Thomas, Electric Engineer, Rialto-bldg, Chicago Ill.

Arce (J.) y Compañia, Electrical Engineers and Contractors, 1a, De San Francisco No. 1, Mexico. (*Jarce Mexico, 294*)

Archer Electric Company, Manufacturers of Electrical Apparatus, La Fayette, Ind.

Arizpe, Rafael R., Electrical Engineer, 6, Calle del 5 de Mayo, Mexico

Armington and Sims Engine Company, Makers of the Standard Engine, Providence, R.I.

Armoux-Hochhausen Electric Company, Electrical Instrument Makers, 478-480, Pearl-st, New York

Armstrong, Chas. G., Electrical Expert, 1,301, Auditorium-bldg., Chicago, Ill.

Arnold, B. J., Consulting Electric Engineer, 565, The Rookery, and (General Electric Company), 4128, Prairie-avenue, Chicago, Ill.

Arnold Electric Co, Manufacturers of Dynamos and Motors, Chester, Pa. (Craig R. Arnold, Electrician and Treasurer)

Ashley Engineering Company, Manufacturers of Electrical Apparatus, 136, Liberty-st, New York. Factory: Hawthorne, N.J.

Askew & Russell, Consulting Engineers and Electricians, P.O. Box 326, Chicago, Ill. (*Weksa Chicago*)

Astoria Electrical Manufacturing Company, Manufacturers of Dynamos, Electrical Machinery, and Apparatus, 14, Dey-st, New York. Factory: Astoria, N.Y.

Atlantic Electric Manufacturing Company, Manufacturers of Electrical Apparatus, Brooklyn, N.Y.

Atwood (A. H.) Electric Manufacturing Company, Makers of the "Atwood" Arc Lamp, 166-174, S. Clinton-st, Chicago, Ill.; and St. Louis, Mo.

Auburn Electric Motor Company, Dealers in Electrical Supplies, Auburn, Me.

Audubon Machine Works, Builders of Electric Motors and Dynamos, 41, Whitney-avenue, New Haven, Conn.

Aurora Electric Company, Makers of the Aurora Dynamo and Motor, 2218 to 2220, Emerald-st, Philadelphia, Pa.

Austin & Brookes, Electrical Engineers, 41, Federal-st, Boston, Mass.

Austin, S. F., Superintendent Compagnie Française du Télégraphe de Paris à New York, 34, Broad-st, New York

Automatic Switch Company, Makers of Automatic Electric Motor Switches, 703-705, Equitable-bldg, Baltimore, Md. (*Automatic Baltimore*)

Ayer (James I.) & Broughton, Electrical Experts and Consulting Engineers, St. Louis, Mo.

Ayres, Dr. S. Browne, Electrician and Proof Physics and Practical Engineering, Tulane University, New Orleans, La.

Ayres, W. J., Electrician, Caixa No. 1, Pernambuco, Brazil.

B

Babcock and Wilcox Company, Boiler Makers, 30, Cortlandt-st, New York.

Bacon, Chas., Manufacturers of Storage Batteries, Rock Hill, Conn.

*BADT, LIEUT. F. B., Electrical Engineer and Manager Western Power and Mining Department, General Electric Company, 173, Adams-st, Chicago, Ill. (*2701*) (Author of Badt's Electrical Handbooks)

Baehr Electric Manufacturing Company, Manufacturers of Electrical Supplies, Newark, N.J.

Bailey, Theodore P., General Manager Railway Department, General Electric Company, 148, Michigan-avenue, Chicago, Ill.

Bailey, W. E., Electrical Engineer, 7 and 8, Equitable-bldg, St. Louis, Mo.

Baillard, E. V., Electrician, Bay Ridge, N.Y.

Bain, Foree, Consulting Electrical Engineer, and Manager Great Western Manufacturing Company, 195-199, South Canal-st, Chicago, Ill.

Baker & Bruce, Electrical Engineers, 1, Beacon-st, Boston, Mass.

Baker (C. H.) & Co, Electric Light and Power Engineers and Contractors, Seattle, Wash.

Baker Electric Lamp Company, Makers of Arc and Incandescent Lamps, Portland, Me.

Baker (H. H.) & Porter (Geo.), Electrical Engineers, 143, La Salle-st, Chicago, Ill.

Ball Engine Company, Makers of the Ball Automatic Cut-off Engine, Erie, Pa.

Ball Electric Light Company, Makers of the Ball Dynamos and Lamps, &c., 404, West Twenty-seventh-st, New York; and Boston, Mass. Factory: Ninth-avenue and Twenty-seventh-street, New York

Ball & Wood Company, Manufacturers of the Ball Automatic Engine, and Dealers in Electrical Supplies, Elizabethport, N.J.; and 15, Cortlandt-st, New York

Ball, W. D., Electrical Engineer, Room 110, 115, Dearborn-st, Chicago, Ill. (1584)

Bangor Electrical Construction and Supply Co, Electrical Engineers, Bangor, Me.

Baquie, George, Dealer in Electrical Supplies, 140, Gravier-st, New Orleans, La.

Barberie, E. T., Consulting Electrician, 2021, Lexington-ave, New York

Barbosa & Co, Importers of Electrical Apparatus, 51, rua Ouvidor, Rio de Janeiro, Brazil

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Barney Ventilating Fan Company, Makers of the Barney Compound Ventilating Fan, Pearl-st, Boston, Mass.

Barr Electric Manufacturing Company, Manufacturers of Electrical Apparatus, 17 and 19, Broadway, New York

Barrett, John A., Electrical Engineer and Expert, 89, Liberty-st, New York; and Elektron Manufacturing Co, Springfield, Mass.

Barrett, Prof. John P., City Electrician, Chicago, Ill.

Barriett, S. L., Electrical Engineer, 161, Washington-st, New York

Barry (J. F.) & Co, Electric Railway Engineers and Contractors, 52, William-st, New York

Bartholomew, Stow & Co, Makers of the "McNutt" Incandescent Lamp, 57, Michigan-ave, Chicago, Ill.

Barth-Bartoshevitch, A., Electrical and Mechanical Engineer, Westinghouse Electric and Manufacturing Co, 160, Arch-st, Allegheny City, Pa.

Bartlett & Co, Electrical Engineers, 23, Rose-st, New York

Barton & Brown, Electricians & Patent Agents, 1445–1451, Monadnock-bldg, Chicago, Ill. *(Brown Chicago, 283)*

Bartol & Co, Electrical Engineers, Provident-bldg, Philadelphia, Pa.

Batchelor, Chas., Electrical Engineer, 33, W. 25th-st, New York

Bates (D. L.) & Co, Makers of the Star Electric Fan, Dayton, O.

Bates, F. C., Consulting Electrical Engineer, c/o Charles H. Warner, Esq., 50, Broadway, New York

Bates, James H., Electrical Engineer, 321, Hudson-st, Hoboken, N.J.

Bates, Joseph, Inventor of the Bates Electric Traction System, Minneapolis, Minn.

Bates Machine Company, Makers of Corliss Engines for Electrical purposes, Joliet, Ill.

Bateson & Hays, Electrical Engineers and Contractors, Englewood, Ill.

Bathurst, Fred., Electrical Engineer, 18, North Church-st, Schenectady, N.Y.

Battenburg & Jones, Electrical Engineers, 435, The Rookery, Chicago, Ill.

Bauer, A. H., Electrical Engineer, Pullman Palace Car Company, Room 310, Pullman-bldg, Dearborn-st, Chicago, Ill.

Bauer, W. F., Electrician, 62, Steuben-st, Orange, N.J.

Baugher, Kurtz & Stewart, Makers of the Rechard Turbine Water Wheel, York, Pa.

Baxter Electric Motor Company, Manufacturers of the Baxter Electric Motor, Biddle, Chester and Chase-sts, Baltimore, Md.

Baxter, H. E. & C., Manufacturers of Electrical Supplies, &c., Cor. Bedford, Canton and Division-sts, Bedford, Mass.

Bayles, Robert N., Electrician, C. and C. Electric Company, 143, Liberty-st, New York; and 365, Henry-st, Brooklyn, N.Y.

B. B. Electric Supply and Construction Company, Manufacturers of Electrical Machinery, New Whatcom, Wash.

Beacon Vacuum Pump and Electrical Company, Manufacturers of the Beacon Incandescent Lamp, Harcourt-bldg, Irvington-st, Boston, Mass.; and 39, Cortlandt-st, New York

Beattie Zinc Works Company, Battery Zinc, &c., Makers, Reading, Mass.

Beausire, A., Electrical Engineer and Manager, Compañia Nacional "Luz Electrica," Calle Cerrito 108, Montevideo

Becker Bros, Electrical Engineers, 43, West Washington-st, Chicago, Ill.

Becker (John) Manufacturing Company, Manufacturers of Electric Motors, Dynamos, Arc Lamps, &c., Fitchburg, Mass.

Beckerleg, James G., Electrical Engineer, 229, South Franklin-st, Chicago, Ill.

Beckwith, N., Maker of Electric Cranes, Lifts, &c., 48, Beverley-st, Boston, Mass.

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Bee Hive Electric Works, Manufacturing Electrical Engineers, Cazenovia, N.Y.

Beers Electrical Fan & Motor Co., Manufacturers of Electrical Fans and Motors, Newark, N.J.

Beggs (John E.) Machinery and Supply Company, Dealers in Electrical Apparatus, 74, Cortlandt-st, New York

Belder (E. E.) Mica Mining Co, Mica Merchants, 12, Broad-st, Boston, Mass.

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Beltman (B.) & Co, Engineers and Electricians, Cincinnati, Ohio

Bemis & McLennan, Electrical Engineers and Contractors, Chemical Bank-bldg, 85, Dearborn-st, Chicago, Ill.

Benbow, Wm. C., Electrical Expert, General Electric Company, Atlanta, Ga.

Benedict and Burnham Manufacturing Company, Manufacturers of Hard-drawn and Annealed Copper Wire, Waterbury, Conn.; and at New York; Boston, Mass., &c.

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Berg & Company, Electrical and Mechanical Engineers, 136, Liberty-st, New York

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Betts, Walter, Superintendent and Electrician, French Atlantic Cable Company, St. Pierre Miquelon, Newfoundland

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Bishop Gutta Percha Company, Makers of Insulated Wires and Cables, &c., 420-426-East Twenty-Fifth-st, New York.

Bishop, J. D., Electrical Expert, Safety Insulated Wire & Cable Company, 234, West 29th-st, New York

Bishop, W. S., Manufacturer of Electric Motors and Electric Light Machinery, 958, Grand-avenue, New Haven, Conn.

Black, Charles N., Electrical Engineer, Brush Electric Company, Belden-avenue, and 1112, Wilson-avenue, Cleveland, O.

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Blades, Harry H., Electrical Engineer and Superintendent, Detroit Motor Company, 1343-1355, Cass-ave, Detroit, Mich.

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Blake, Francis, Electrical Engineer, Auburndale, Mass.

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Blake & Knowles Steam Pump Works, Limited, Mechanical Engineers, 113, Federal-st, Boston, Mass.

Blake, Prof. Lucien I., Electrician and Professor of Physics and Electrical Engineering, Kansas State University, Lawrence, Kansas

Blake, Theo. W., Consulting Electrician, National India Rubber Company, Bristol, R.I.

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Blanchard, Albert, Maker of the Downward Draft Steam Boiler, 427, The Rookery, Chicago, Ill.

Bliss (E. W.) Company, Manufacturers of Presses and Special Tools for Electrical Appliances, 17, Adams-st. Brooklyn, N.Y.

Bliss Engineering Company, Contracting and Consulting Electrical Engineers, Atlantic-bldgs, Washington, D.C.

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Blodgett, George W., Consulting Electrician and Electrical Engineer, Boston and Albany R.R., Boston, Mass.

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Board of Electrical Control for the City of New York, 1266, Broadway, New York. (Schuyler S. Wheeler, Electrical Expert)

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Bohm, Ludwig K., Ph.D., Consulting Electrical Expert, 81, Nassau-st, New York

Bohn, Christian C., Dealer in Electrical Supplies, 1486, Broadway, New York

Bosch, Adam, Electrical Engineer, Superintendent Fire Alarm Telegraph, Newark, N.J.

Bosson, F. N., Electrician, Calumet and Hecla Mining Company, Calumet, Mich.

Boston Braid Manufacturing Company. Makers of Silk Braid for Incandescent Lamp Filaments, 27, Beach-st, Boston. Mass.

Boston Incandescent Lamp Company. Manufacturers of Incandescent Lamps, 70, Pearl-st, Boston. Mass.

Boston Electric Wire Company, Wire Manufacturers, Allston, Mass.

Boston Electric Company, Manufacturers of Electrical Apparatus, 548, Washington-st, Boston, Mass.

Boston Motor Company, Makers of the Boston Motor and Battery Outfits. 17. Battery March-st, Boston, Mass.

Bottome, Turner D., Electrician, Indianapolis, Ind.

Bottomley, Harry, Electrical Engineer and Superintendent, Marlborough Electric Company, Marlborough, Mass.

Boulton Carbon Manufacturing Company. Manufacturers of Electric Light Carbons and Carbon Brushes, North Tonawanda, N.Y.

Bowers, Geo. E., Manufacturer of Dynamos and Motors, 527, Main-st, Fitchburg, Mass.

Boynton, Edward C., jun., M.E., Electrical Engineer, Erie, Pa.

Boynton, E. M., Electrical Engineer, West Newbury, Mass.

Brackett, Prof. C. F., Consulting Electrician, College of New Jersey, Princeton. N.J.

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Bradbury-Stone Electric Storage Company, Makers of the "Ideal" Storage Battery, 5-9, Grand-st, Lowell, and 409, Exchange-bldg, Boston, Mass.

Braddell, Alfred E., Electrical Inspector Underwriters' Association (Middle Department) 308, Walnut-st, Philadelphia, Pa.

Bradley, C. S., Electrical Engineer, General Electric Company, Lynn, Mass.

Bradley Electric Power Company, Manufacturers of Electrical Machinery, 63, Broadway, New York

Bradley, Fred W., Electrical Engineer, Ansonia Electric Company, 104, Michigan-avenue, Chicago, Ill.

Bradley General Electric Company, Dealers in Electrical Supplies, 119, La Salle-st, Chicago, Ill.

Bradley Manufacturing Co, Manufacturers of Electric Light Fittings, Ashtabula, O.

Brady Eanufacturing Company, Manufacturers of Electrical Apparatus, 3, Washington-st, Brooklyn, N. Y.

Bratey, Geo. A., Consulting Electrical Engineer, American Railroad Improvement Company, 95, Milk-st, Boston, Mass.

Bray (J. F.) & Co, Telegraph and Telephone Apparatus Makers, 55, Dry-st, New York

Brayshaw, James, Telegraph Engineer, Great Southern Railway Company's Telegraphs, Buenos Ayres

Bridgeport Brass Company, Manufacturers of Wire (Bare and Insulated) for Electric Conductors, Bridgeport, Conn.

Brigham, Archie V., Electrical Engineer, 2742, Washington-av, St Louis, Mo. *(4464)*

Briggs (W. W.) and Co, Electrical Engineers, San Francisco, Cal.

Briner, C. J., Electrical Engineer, Central Electric Construction Company, 515, Walnut-st, St. Louis, Mo.

Brixey, W. R., "Kerite" Insulated Telegraph Wire and Kerite Cable Manufacturer, 202, Broadway, New York; and 225, Dearborn-st, Chicago, Ill. Factory: Seymour, Conn. *(Day hewit New York)*

Bristol's Manufacturing Company, Makers of Bristol's Recording Voltmeter, Waterbury, Conn.; and 121, Liberty-st, New York

Brooklyn Electric Construction Company, Electrical Engineers and Apparatus Makers, 71-73, Broadway, New York

Brooklyn Electric Manufacturing Company, Manufacturers of Electrical Apparatus, 286-290, Graham-st, Brooklyn, N. Y.

Brooks, David, jun., Electrician, 107, South Third-st, Philadelphia, Pa.

Brooks, H. B., Electrician and Superintendent to the Piqua Electric Company, Piqua, Ohio

Brooks, Morgan, Electrical Engineer, and General Manager, Electrical Engineering and Supply Company, 249, Second-Avenue, Minneapolis, Minn.

Brooks Underground Telegraph Construction Company, Limited, 307, Walnut-st, Philadelphia, Pa.

Brophy, William, Inspector and Electrical Expert, Manufacturers' Mutual Insurance Company, 35, Milk-st, Boston; and 17, Egleston-st, Jamaica Plain, Mass.

Brown Dynamo Electric Telephone Company, Manufacturers of Telephones, Moline, Ill.

Brown, Alex. S., Electrical Engineer, 39, Cortlandt-st, New York

Brown, Alfred S., Electrical Engineer, Western Union Telegraph Company, 195, Broadway, New York

Brown, C. A., Electrical Engineer and Patent Expert, Barton & Brown, 1445-1451, Monadnock-bldg, Chicago, Ill. *(Brown Chicago, 283)*

Brown Electric Company, Manufacturers of Electrical Apparatus, Cor. Sumner & Federal-sts, Boston, Mass.

Brown Telephone and Telegraph Company of Chicago, 1225, Manhattan-bldg, Chicago, Ill.

Brown, Harold P., Consulting Electrical Engineer, General Electric Company, Edison-bldg, 44, Broad-st, New York

Brown, J. Stanford, Consulting Electrical Engineer, Neftel O'Connor Company, (Incorporated), 126, Liberty-st, New York

Brown, James, Superintendent, Direct United States Cable Company, 40, Broadway, New York

Brown (M. W.) & Co, Electrical Engineers, cor. Federal and Sumner-streets, Boston, Mass.

Browne, William, L., Incandescent Lamp Manufacturer, Plattsmouth, Neb.

Browning, Victor Reed, Electrical Engineer, Short Electric Railway Company, Monadnock-bldg, Chicago, Ill.

Bruce & Broadman, Electrical Engineers, 71, Union-st, Memphis, Texas

Bruce & Cook, Manufacturers of Bare and Insulated Wire, 190, Water-st, New York

*Brush, Chas. Francis, Electrical Engineer and Inventor, Brush Electric Company, 956, Euclid-avenue, Cleveland, Ohio

Brush Electric Company, Manufacturers of Electrical Machinery, Cleveland, O.; 115, Broadway, New York; and 225, Dearborn-st, Chicago, Ill.

Bryan, Marsh & Co, Manufacturers of Galvanic Batteries, Fan Moters, &c., 136, Liberty-st, New York

Bryan, William H., M.E., Electrical and Mechanical Engineer, 1, Turner-bldg, St. Louis, Mo.

Bryant Electric Company, Dealers in Electrical Apparatus, Bridgeport, Conn.; and 1522, Monadnock-bldg, Chicago, Ill.

Brydges, J. K., Electrical Engineer, Thomson-Houston Electric Company, Augusta, Ga.

Bubert, J. F., Electrical Engineer, Mather Electric Company, 116, Bedford-st, Boston, Mass.

Buchel Machine Works, Manufacturers of and Dealers in Electrical Supplies, 101, Conti-st, New Orleans, La.

Buck (W. J.) Sons & Co, Manufacturers of Electric Light Fittings, 415, North Eighth-st, Philadelphia, Pa.

Buckeye Electric Company, Makers of Electric Light Fittings, P.O. Box 123, Cleveland, Ohio; and 49, Dey-st, New York

Buckeye Engine Company, Makers of the Buckeye Automatic Cut-off Engine, Salem, Ohio

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Buffalo Electric Construction Company, Manufacturing Electrical Engineers, Laird-bldg, Niagra-st, Buffalo, N. Y.

Buffalo College of Commerce (Practical School of Electricity), 327, 329 and 331, Washington-st, Buffalo, N.Y.

Builders' Insulating Tube Company, Makers of Electric Light Wire Conduits, 823, Washington-st, Lynn, Mass.

Bulkley, J. Norman, Electrical Engineer, Pennsylvania General Electric Company, Scranton, Pa.

Bullock (M. C.) Manufacturing Company, Makers of High Speed Steam Engines, and Agents for Messers Willans & Robinson, Ltd, 117, W. Lake-st, Chicago, Ill.

Bunnell (J. H.) & Co, Manufacturers of Telegraph Instruments and Electric Supplies, 76, Cortlandt-st, New York. (*Bunnell, New York, 4116 Cortlandt*)

Burket, J. U., Dealer in Electrical Supplies, Washington, D.C.

Burleigh, Chas. B., Superintendent of Isolated Department, General Electric Company, 620, Atlantic-avenue, Boston, Mass.

Burlingame, E. E., Chemical and Engineering Expert, 1736-1738, Lawrence-st, Denver, Colo. (*1517*)

Burnett, Douglass, B. Sc., Arc Lighting Expert, 42, Livingston-st, Brooklyn, N. Y.

Burns (Chas. F.) & Co, Electrical Engineers & Contractors, Rochester, N. Y.

Burnet, H. W., Electrical Engineer and Manufacturer of Electrical Apparatus, 12, North Grove-st, East Orange, N.J.

Burt & Tobey, Manufacturers of Electrical Specialities, 22, Middle-st, New Bedford, Mass.

Burton, George D., Electrical Engineer, President Electrical Forging Company, 194, Washington-st, Boston, Mass.

Burton, J. L., Manager, West Coast Telephone Company, 13, Galeria San Carlos, Santiago, Chili. (*Electrode Santiago*)

Bush (Charles S.) & Co, Dealers in Electrical Supplies, 20, Exchange-pl, and 212, Broad-st, Providence, R.I.

Bushnell & Co, Dealers in Electrical Apparatus, 35, Broadway, New York

Bussey, Robert D., jun., Electrical Engineer, 327, Washington-st, Buffalo, N. Y.

Butler Hard Rubber Company, Manufacturers of Battery Cells, 33, Mercer-st, New York

Byllesby, H. M., Electrical Engineer, General Manager North-West General Electric Company, 403, Sibley-st, St. Paul, Minn.

— C —

Cabot, John Alfred, City Electrician, City Hall, and 123, Garfield-pl, Cincinnati, O.

"C. and C." Electric Company, Incorporated, 143, Liberty-st, New York; and at Garwood, N.J. (A. Mitchell Hall, General Manager)

Cadmus Electric Manufacturing Company, Transformer Makers, Elkhart, Ind.

Cahoon, J. B., Electrical and Mechanical Engineer, Manager Expert Dept., General Electric Co., 68, Baker-st, Lynn, Mass.

Caldwell, Edwd., A.B., M.E., Editor, *Street Railway Gazette*, Monadnock Block, Chicago, Ill.

Caldwell, Fordyce S., Electrical Engineer, Proprietor Western Electric Construction Company, 503, Delaware-st, Kansas, Mo., and 151, Henry-st, Brooklyn, N.Y.

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Callman (W. C.) & Co, Dealers in Electrical Supplies, 136, Liberty-st, New York; and 679, Broad-st, Newark, N.J.

Calumet Electric Manufacturing and Engineering Company, Manufacturers of Electrical Machinery, 172-174, S. Clinton-st, Chicago, Ill.

Campbell Electric Supply Company, Manufacturers of Electric Wires, 101, High-st, cor. Congress-st, Boston, Mass.

Canton Electrical Company, Manufacturers of Electrical Machinery, 28, Cedar-st, Canton, O.

Canfield, Milton C., Electrical Engineer, 18, Clinton-st, Cleveland, O.

Card Electric Motor and Dynamo Co, Manufacturers of Electric Motors, Dynamos, Regulators, &c., cor. Broadway and Hunt-st, Cincinnati, Ohio

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Carlisle Manufacturing Company, Manufacturers of Electrical Machinery, Carlisle, Pa.

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Carpenter Electric Company, Manufacturers of Electrical Machinery, 116-118, Franklin-st, Chicago, Ill.

Carpenter Electric Power and Light Company, Manufacturers of Electrical Apparatus, East St. Louis, Ill.

Carpenter Enamel Rheostat Company, Makers of Rheostats, Bridgeport, Conn. (Selling Agent: Chas. D. Shain, 136, Liberty-st, New York)

Carpenter, Eugene F., Electrical Engineer and Superintendent, United Gas Improvement Company, Concord, N.H.

Carpenter, F. H., Superintendent, Western and Brazilian Telegraph Company, Maranham

Carpenter-Nevens Electric Heating Company, Manufacturers of Electric Heating Apparatus, 106½, First-avenue, North Minneapolis, Minn.

Carr & Smith, Electrical Engineers, Minneapolis, Minn.

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Cassels, W. R., Manager of the River Plate Electricity Company, Limited, 858, Calle Cangallo, Buenos Ayres

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Central and Consolidated Electric Company, Manufacturers of Electrical Apparatus, 68, Broad-st, Elizabeth, N.J.

Central Electric Company, Manufacturers of Electrical Supplies, 116 and 118, Franklin-st, Chicago; and Peoria, Ill.

Central Electric Construction Company, Electrical Engineers and Contractors, 919, Locust-st, St. Louis, Mo.

Central Electric Heating Company, Makers of Electric Heaters, 617-620, Havemeyer-bldg, 26-28, Cortland-st, New York

Central Gas & Electric Fixture Company, Manufacturers of Electric Fixtures, 224-232, Canal-st, and 118-126, Walker-st, New York

Central Machine and Foundry Company, Makers of the Lechtenberg Electric Elevator, Quincy, Ill.

Central Power Company, Electric Traction Engineers and Contractors, Newark, N.J. (J. M. Smith, Secretary)

Central and South American Telegraph Company, 37 and 39, Wall-st, New York.

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Chase Turbine Manufacturing Company, Makers of the "Chase" Turbine, Orange, Mass.

Cheever, Charles A., Electrical Engineer, 13, Park-row, New York

Cheney, Frederick A., General Manager and Electrician, Elmira Illuminating Company, 222, Railroad-avenue, Elmira, N.Y.

Cheney, W. C., Chief Electrician, Portland General Electric Company, Portland, Ore.

Chesley Electric Co, Electrical Engineer, 171, Broadway, New York; and Hoboken

Chesney, C. C., Electrical Engineer, Stanley Electric Manufacturing Company, Pittsfield, Mass.

Chicago Electrical Construction Company, Manufacturers of Electrical Apparatus, Chicago, Ill.

Chicago Electrical Manufacturing Co, Manufacturers of Electrical Apparatus, 73-75, West Jackson-st, Chicago, Ill.

Chicago Electric Motor Company, Makers of the Chicago Fan Motor, 313, South Canal-st, Chicago, Ill.

Chicago Incandescent Light Company, Manufacturers of Electrical Supplies, 75, North Clinton-st, Chicago

Chicago Insulated Wire Company, Manufacturers of Insulated Wires, Sycamore, Ill.; and 207, S. Canal-st, Chicago

Child, Frank W., Electrical Engineer, 115, Broadway, New York

Chinnock, C. E., Electrical Engineer, 137, Sixth-avenue, Brooklyn, N.Y.

Chinnock, F. R., Electrical Engineer, 143, Liberty-st, New York

Chism, George F., and Chief Engineer, Standard Engineering Company of North America, 92, State-st, Albany, N.Y.

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Chloride of Silver Dry Cell Battery Company, Makers of Test Batteries, &c, Baltimore, Md.

Christmas, Adolph Frederick, Electrical Engineer, Manager Electrical Department, Johnson Company, Johnstown, Pa.

Chubbuck, H. E., Manager and Electrician, New Omaha General Electric Company, Omaha, Neb.

Churchill, Arthur, Electrical Engineer, General Electric Company, 5, South Church-st, Schenectady, N.Y.

Churchward, Alex., Electrician and Inventor of the C. & P. Dynamos, &c., Easton Electric Company, 643, Kent-avenue, Brooklyn, N.Y.

Cincinnati Electric Engine Co, Makers of Electric Motors, 12, East Third-st, Cincinnati, Ohio

Claflin Dental Manufacturing Co, Manufacturers of Dynamos and Motors, 38 and 44, Front-st, Worcester, Mass.

Clapperton, Geo., Superintendent, Commercial Cable Company, 1, Broadway, New York

Clark, C. A., Manufacturer of Insulated Wire and Cables, 146, Franklin-st, Boston, Mass.

Clark Bros. Makers of the Mayo Dynamos and Motors, and the Belmont Steam Engines, Belmont, N.Y.

Clark & Cowles, Engineers and Manufacturers of Electric Light Fittings, Plainville, Conn.

Clark Electric Company, Electrical Engineers, Corbin-bldg, 192, Broadway, and 11, John-st, New York. (Ernest P. Clark, Electrician)

Clark (Ernest L.) Company, Dealer in Electrical Apparatus, 331, The Rookery, Chicago, Ill.

Clark, E. W., Maker of Machines for covering Electric Light Wires and Cables with Rubber and other Compounds, 31, Wells-st, Hartford, Conn.

Clark & Marshall, Dealers in Electrical Supplies, 345, The Rookery, Chicago, Ill.

Clarke, Charles L., Electrician and Mechanical Engineer, Greenwich, Conn.

Claus (P.) Dynamo Co., Electrical Engineers, 550-552, West 36th-st, New York

Clemens Electrical Manufacturing Company, Manufacturers of Electric Light and Railway Supplies, Attleboro, Mass.

Clement, Lewis M., Electrical Engineer, 1013, Central-avenue, Oakland, Cal.

Cleveland Electrical Manufacturing Company, Electrical Apparatus Makers, 837, Sheriff-st, Cleveland, Ohio (*L.T.*)

Cleveland Electric Railway Company, Electric Railway Engineers, Cleveland, O. (C. W. Wason, Electrical Engineer and Purchasing Agent)

Cleveland General Electric Company, Manufacturers of and Dealers in Electric Machinery, Cleveland, O.

Cleveland Motor Company, Electrical Engineers, Ninth National Bank-bldg, 409, Broadway, New York; and Chicago, Ill.

Cleveland Surgical and Electrical Instrument Company, Manufacturers of Electrical Instruments, Cleveland, O.

Cleveland & Taylor, Practical Electricians, 5-7, Dey-st, New York

Cleveland, W. B., Electrical Engineer, 309, Perry-Payne-bldg, Cleveland, Ohio

Cleverly Electrical Works, Electrical Supply Makers, 1018, Chestnut-st, Philadelphia, Pa. (H. A. Cleverly, Manager)

Clipperton, Henry, Telegraph Engineer, Western and Brazilian Telegraph Company, Rio de Janeiro, Brazil

Clohesey, Thos. F., Electrical Expert, 805, N. Y. Life-bldg, Kansas City, Mo.

Clonbrock Steam Boiler Works, Makers of the Morrin "Climax" Steam Generators, Smith, Court, Lorraine and Cramer-sts, Brooklyn, N.Y.

Clower, John M., Electrical Engineer, 300, Main-st, Dallas, Texas

Clunn, C. S., Electrical and Mechanical Engineer, Scott-bldg, 1217, Filbert-st, Philadelphia, Pa.

Clyde Electric Motor Company, Manufacturing Electricians, 147, Charles-st, and (Factory) 43, South Main-st, Providence, R.I.

Cobb, Danley & Knott, Electrical Engineers and Contractors, 136, Liberty-st, New York

Colburn Electric Manufacturing Company, Manufacturing Electrical Engineers, 170, Main-st, Fitchburg, Mass.

Colburn, Ralph, Electrical Engineer, Holliston, Mass.

Colby, E. A., Consulting Electrical Engineer, Messrs, Baker & Co, Lock Box 313, Newark, N.J.

Cole (La Fayette) & Co, Dealers in Electrical Supplies, Crocker-bldg, San Francisco, Cal.

Coleman Battery Company, Manufacturers of Storage Batteries, Chicago, Ill.

Coleman, Clyde, Electrical Expert, Electric Speciality Company, 85, Fifth-avenue, Chicago, Ill.

Colgate, Geo. L., Electrical Engineer, and Dealer in Electrical Supplies, 136, Liberty-st, New York. (*Colgate New York*)

Columbia College (School of Mines), 41, East 49th-st, New York. F. B. Crocker, E.M., Prof. of Electrical Engineering.

Columbia Electric Company, Manufacturers of Dynamos, Motors, &c, 207, East Fourth-st, St. Paul, Minn.

Columbia Incandescent Lamp Co, Manufacturers of the Columbia Incandescent Lamp, 1912-1914, Olive-st, St. Louis, Mo.

Columbia Machine Works, Manufacturers of Electrical Apparatus, 11-17, South Jefferson-st, Chicago, Ill.

Columbia Manufacturing Company, Manufacturers of Electrical Supplies, Seattle, Wash.

Columbia Manufacturing and Supply Company, Manufacturers of the "Jupiter" Dry Battery, 340-342, Dearborn-st, Chicago, Ill.

Columbus Electrical Machine Works, Manufacturers of Electrical Apparatus, Columbus, O.

Columbus Electrical Supply and Construction Company, Electrical Engineers and Contractors, P.O. Box 151, Columbus, Ga.

Colville, Frank C., Contracting Electrician N.W. Cor., Seventh-avenue, and E. 20th-st, Oakland, Cal.

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Colvin, Frank R., Treasurer and Business Manager, *The Electrical Engineer* (Incorporated), 203, Broadway, New York (*Lengineer New York*; *3860 Cortlandt*)

Commercial Electric Engineering Company, Manufacturing Electrical Engineers, 47, Hodges-Block, Detroit, Mich.

COMMERCIAL CABLE COMPANY (Mackay-Bennett Cables) Washington-bldg, 1, Broadway, New York. (John W. Mackay, President; Geo. G. Ward, Vice-President and General Manager; J. O. Stevens, Secretary; Albert Beck, Ass. Secretary.) (*See also* BRITISH DIVISION *for European Branches.*) **See Advt., p. cxxix.**

Commercial Electric Company, Electrical Engineers and Manufacturers, 55 to 57, Gratiot-av, Detroit, Mich.

Commercial Electric Company, Electrical Engineers, 113, South Tennessee-st, Indianapolis, Ind.; and 455, The Rookery, Chicago.

Commercial Electrical Supply Co. Manufacturers of Electrical Supplies, 821, Pine-street, St. Louis, Mo. (*4152*)

Commonwealth Electric Company, Manufacturers of the Commonwealth Fan Motors, 413, Market-st, Philadelphia.

Compañia (anónyma) de Luz Electrica de Londres, Casilla 74, Rosario de Santa Fé, Argentine Republic. (Ernesto Danvers, Manager)

Companhia Brazileira de Electricidade, Manufacturers of Electrical Apparatus, 109-117, Rua Ouvidor, Rio de Janeiro.

Compañia de Alumbrado Electrico, Electric Light Engineers, 14, Calle Yerbal, Monte Video, Uruguay

COMPAGNIE FRANÇAISE DU TÉLÉGRAPHE DE PARIS À NEW YORK, 34, Broad-st, 11, East 14th-st, 1, Mercer-st, and Pulitzer-bldg, New York. (S. F. Austin, Superintendent) (*Phenaust New York*). (*See also* BRITISH and CONTINENTAL DIVISIONS)

Compañia de Electricidad del Rio de la Plata, Limitada, 423, Calle Rivadavia, and P.O. Box 931., Buenos Ayres; Usine de la Luz Electrica, La Plata; Calle Corrientes, Esquina Salta, Rosario de Santa Fé; and at Cordoba, and Tacuman, Argentine Republic. W. R. Cassels, Manager; Frank Cassels, Superintendent. (*Luciente Buenos-dires*). (*See* River Plate Electricity Company, Limited, *in* BRITISH DIVISION.)

Compañia Nacional "Luz Eléctrica," Electric Light Engineers and Contractors, Calle Cerrito 108, Montevideo. (A. Beausire, Manager)

Compañia de Telefonos de Mexico, Mexico. (Ernest and Enrique Ascorve, Managers)

Compañia Telegrafica-Telefonica de la Plata, Buenos Ayres

Complete Electric Construction Company, Contractors of Electrical Construction, 121, Liberty-st, New York. (J. A. Seely, President and General Manager)

Compound Electric Motor and Dynamo Company, Manufacturers of Electrical Machinery, Chicago, Ill.

Comstock, L. K., Consulting Electrical Engineer, 1437 and 1438, Monadnock-bldg, Chicago, Ill.

Condict, G. Herbert, Electrical Engineer, and General Manager of the Electric Car Company of America, 4720, Green-st, Germantown, Philadelphia, Pa.

Connecticut Dynamo and Motor Company, Manufacturing Electrical Engineers, Mechanic-street, Hartford, Conn.

Connecticut Motor Co, Manufacturers of Automatic Electric Motors, &c., Plantsville, Conn.; and 17, Broadway, New York

Connecticut Royal Arc Company, Makers of the "Howard" Incandescent Lamp, Hartford, Conn.

Connell, William, Electrical Engineer, 37, Hazlewood-ave., Pittsburgh, Pa.

Conover (C. E.) Insulator Company, Manufacturers of Insulators, 366, Vine-street, Cincinnati, O.

Conover Manufacturing Co, Consulting and Mechanical Engineers, Makers of the Conover Condenser, 39-41, Cortlandt-st., New York

Consolidated Electric Company, Electrical Engineers, Manufacturers of Insulated Wire, &c., Worcester, Mass.

Consolidated Electric Mannufacturing Company, Makers of Arc and Incandescent Dynamos and Motors, 154, Franklin-st, and 155 and (Factory) 355, Congress-st, Boston, Mass

Consolidated Electric Motor Co, Manufacturers of Electric Motors, 77, Bedford-st, Boston, Mass.

Consolidated Electric Storage Co, Manufacturers of the Julien System of Storage Battery Traction, Edison-bldg, 44, Broadstreet, New York. Works: Camden, N.J.

Consolidated Engineering Company, Consulting and Contracting Electrical Engineers, 821, Pine-street, St. Louis Mo.

Continental Dynamo Company, Electrical Engineers and Makers of the "Continental" Dynamo, 63, Broadway, New York.

Continental Electric Construction Co, Electrical Engineers and Contractors, 1118, Chamber of Commerce-bldg, Chicago, Ill.

Cooke (Edward T.) Electric Company, Electric Light Contractors and Engineers, 1408, Chestnut-st, St. Louis, Mo. (*1281*)

Cooper, (C. & G.) & Co., Electrical Engineers, Mount Vernon, O.

Cope Electric Pilot Line Company, Manufacturers of the Cope Come-Along Apparatus, 8, North Sixth-st, Philadelphia, Pa.

Copeland (E. T.) & Co, Dealers in Electrical Supplies, 106, Liberty-st, and 111, Cedar-st, New York

Corliss Steam Engine Company, Makers of the "Corliss" Electric Light Engine, Providence, R.I.

Cornell, Charles L., Electrical Engineer, Cornell Engineering Company, 45, Broadway, New York

Cornell Electrical Engineering Company, Consulting and Contracting Electrical Engineers, 45, Broadway, New York

Cornell Pheneger Chemical Company, Makers of Primary Batteries, Columbus, O.

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Cornell University, Ithaca, N.Y. (Edward L. Nichols, Ph.D., Professor of Physics; Harris J. Ryan, M.E., Associate Professor of Electrical Engineering)

Cornish, James T., Electrical Engineer, and Contractor and Engineer to the Companhia Luz Electrica, São Carlos de Pinhal, Estado de São Paulo, Brazil

Cory, Clarence L., Consulting Electrician and Professor of Electrical Engineering, University of California, Berkeley, Cal.

Costillo, J. E., Manufacturing Electrician, Cor. Hudson-avenue and Concord-street, Brooklyn, N.Y.

Courter, Albert C., Maker of the Crown Dynamo, 209, Market-st., Newark, N.J.

Courtis & Smith, Electricians, Metallurgists and Assayers, 27, Larned-street West, Detroit, Mich.

Cowles, Alfred H., Electrical Engineer, Technical Adviser to the Cowles Electric Smelting and Aluminium Company, 656, Prospect-street, Cleveland, O.

Cowles Electric Smelting and Aluminum Company, Producers of Aluminum and Silicon Bronze, Lockport, N.Y. (*Cowles New York*)

Cowles, Joseph W., Electrical Engineer, General Electric Company, 620, Atlantic-ave., Boston, Mass.

Cox, Ernest Spencer, Electrical Engineer, c/o Messrs. Burlamacchi-Vinci y Cia, Calle Rivadavia 283, San Juan, Argentine Republic

Craig, J. Hally, Consulting Electrical Engineer, John Hancock-bldg, 178, Devonshire-st., Boston, Mass.

Craighead, H., Electrical Engineer, Westinghouse Electric Co, Pittsburg, Pa.

Cramp & Co., General Engineers and Turbine Makers, Philadelphia, Pa.

Crandell Manufacturing Company, Manufacturers of Electrical Specialities, 66, N. 4th-street, Philadelphia, Pa.

Crane Elevator Company, Makers of Electric Elevators, Chicago, Ill.

Crane, F. N., Electrical Engineer, 179, Market-st, Newark, N.J.

CRANE, W. F. D., M.E., E.E., Electrical and Mechanical Engineer, Manager of the Electrical Department, H. W. Johns Manufacturing Company, 87, Maiden-lane, New York

Craven (S. Norris) & Co., Limited, Makers of Electric Elevators, 515, Mulberry-street, Philadelphia, Pa. (*1628*).

Creaghead Engineering Company, Electrical Engineers and Dealers in Electrical Supplies, 296, Plum-street, Cincinnati, O. (Thos. J. Creagshead, Manager)

Crehore, Dr. Albert C., Electrician, Assistant Profrssor of Physics, Dartmouth College, Hanover, N.J.

Cresson (Geo. V.) & Co., Electrical Engineers Cor. 18th and Alleghany-ave., Philadelphia, Pa.

Crocker-Wheeler Electric Company, Electrical Engineers and Makers of Electric Motors, Taylor-bldg., 39 and 41, Cortlandt-st, New York. Works: Ampère, East Orange, Newark, N.J. (*Crockwheel New York.*)

*Crocker, Francis B., Professor of Electrical Engineering, Columbia College, New York

Crodus Electric Company, Manufacturing Electrical Engineers, Milwaukee, Wis.

Crosby Electric Company, Manufacturers of Electrical Apparatus, 110, Fifth-avenue, and 121, South Fifth-avenue, New York

*Crosby, Oscar T., Electrical Engineer, General Manager Railway Department, General Electric Company, 44, Broad-st, New York

Cross, A. Murray, Telegraph, Engineer, Empresa del Telegrapho Submarino, Valparaiso, Chili

Cross, Prof. C. R., Thayer Professor of Physics and Director of the Rogers Laboratory, Massachusetts Institute of Technology, Boston, Mass.

Cross, John A., Consulting Electrical Engineer, Central Lighting Station, Geneva, N.Y.

Crouch Electric Supply Company, Manufacturers of Electrical Supplies, Portland, Ore.

Crouse-Tremaine Carbon Company, Electric Light Carbon Manufacturers, Fostoria, O.

Crowdus Chemical Electric Company, Manufacturers of the "Crowdus" Multipolar Cell Battery, Memphis, Tenn.

Crown Electric Manufacturing Company, Manufacturers of Electrical Apparatus, Bridgeport, Conn.; and at 18, Cortlandt-st, New York

Culbertson, Dr. J. N., Electrical and Telephone, Engineer, Bell Telephone Company, 14 W. Seneca Main-st, Buffalo, N. Y.

Cummings and Engleman Conduit Company, Makers of Electric Light Wire Conduits, Telephone-bldg, Detroit, Mich

Cummins, E. C., Electrician, Western and Brazilian Telegraph Company's s.s. "Norseman," Pernambuco, Brazil

Cumner, Craig & Co, Consulting Electrical Engineers, John Hancock-bldg, 178, Devonshire-st, Boston, Mass.

Cumner, Arthur B., Cumner, Craig & Co, John Hancock-bldg, 178, Devonshire-st, Boston, Mass.

Cunha, Manuel Ignacio de, Manager of the Electrical Section, Empreza Industrial Gram-Para, Para, United States of Brazil

Cuntz, Johannes H., Electrician, 325, Hudson-st, Hoboken, N.J. *Cuntz Hoboken*

Currie, Stanley, B.A., Electrical Expert, Drexel-bldg, Philadelphia, Pa.

Curtis, Charles G., Electrical Engineer and President, Curtis Electric Manufacturing Co, Pacific-av, Jersey City, N.J.

Curtis Electric Manufacturing Company, Makers of Electric Railway Machinery, Pacific-av, Jersey City, N.J.

Curtiss, Geo. F., Electrical Engineer, General Electric Company, 180, Summer-st, Boston, Mass.

Cushing Electric Co, Electrical Engineers, Boston, Mass.

Cushing & Morse, General Western Agents for Day's Kerite, 225, Dearborn-st, Chicago, Ill.

Cushman, Abe L., Electrcian and Chemist, Granite State Electric Company, 31, South Main-st, Concord, N.H.

Cushman, Holbrook, Electrical Engineer, 337, West Twenty-second-st, New York

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Cutler and Hammer, Electrical Engineers, 313, South Canal-st, Chicago, Ill. (*3493 Main*)
Cutter Electrical and Manufacturing Company, Electrical Engineers and Manufacturers of Electrical Specialities, 27, South Eleventh-st, Philadelphia, Pa.
Cutter, Geo., Dealer in Electrical Supplies, 851-855, The Rookery, Chicago, Ill.
Cuttriss, Charles, Electrical Expert, Electrician to the Commercial Cable Company, 1, Broad-st, New York

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"D. D." Electric Motor Co, Manufacturers of Electric Motors, 327, St. Peter-st, St. Paul, Minn.
D. and D. Electric Manufacturing Company, Manufacturers of and Dealers in Electrical Supplies, 745-747, Washington-avenue, N. Minneapolis, Minn.
Daft, Leo, Consulting Electrical Engineer and Contractor, Everett, Wash.
Dahl Electric Company, Manufacturers of the "Success" Arc Lamp and Dealers in Electrical Supplies, 120, Liberty-st, New York
Dale Manufacturing Company, Makers of Electrical Apparatus, 22, Cortland-st, New York
Dallas Electrical Construction Company, Dealers in Electrical Supplies, Dallas, Texas
Dallett (Thos. H.) & Co, Electrical Engineers and Makers of the Billberg Motor, York-st and Sedgeley-avenue, Philadelphia, Pa.
Dame, Frank L., Electrical Engineer, Engineering Department North-West General Electric Company, Portland, Ore.
Dana, R. K., Electrical Engineer, Agent Washburn and Moen Manufacturing Company, 16, Cliff-st, New York
Daniell, Francis G., Electrical Engineer, State-st H.R.R. Company, New Haven, Conn.
Danvers, Ernesto, Electrical Engineer, 186, Calle Libertad, Rosario de Santa Fé, Argentine Republic
Darrin, David H., Electrical Engineer, 128, Erie County Bank-bldgs, Buffalo, N.Y.
Davenport, G. W., Electrical Engineer, General Manager Thomson-Houston International Electric Company, 44, Broad-st, New York (*Daport New York*)
Davids, Richard W., Consulting Electrical Engineer and Expert, 308, Walnut-st, Philadelphia, Pa.
Davidson, C. L., Superintendent, Western and Brazilian Telegraph Company, Rio Grande do Sul, Brazil
Davidson Ventilating Fan Company, Makers of the Davidson Motor Fan, 137, Milk-st, Boston, Mass.
Davies, John E., A.M., M.D., LL.D., Professor of Electricity and Magnetism, and Mathematical Physics, Wisconsin University, 523, Carroll-st, Madison, Wis.
Davis, Charles H., C.E., Consulting Electrical Engineer, 120, Broadway, New York; and 308, Walnut-st, Philadelphia, Pa.
Davis Electrical Works, Manufacturers of Incandescent Lamps, Springfield, and Boston, Mass.
Davis, Joseph P., Consulting Electrical Engineer, Phœnix Construction Company, 115, West Twenty-Eighth-st, New York
Davis, Josiah R. T., Electrical Engineer, 104, Havemeyer-bldg, New York
DAVIS, L. K., Electrical and Mechanical Engineer, 1, Broadway, New York. **See Advts., pp. 38 and 830**
Davis, T. H., Superintendent, Western and Brazilian Telegraph Company, Rio de Janeiro, Brazil
Day (Thomas) & Co, Dealers in Electrical Supplies, 222, Sutter-st, San Francisco, Cal. (*Symmesco San Francisco*)
Dayton Globe Iron Works Company, Makers of the New American Turbine, Dayton, O.
Dayton Manufacturing Company, Makers of the "Silvey" Storage Battery, Dayton, O.
Degroot Electric Company, Electrical Instrument Makers, 66, Liberty-st, New York
De Kosenko and Hetherington Manufacturing Company, Designers and Makers of Electroliers, 508, Penn Mutual-bldg, Philadelphia, Pa., (C. H. Converse, Secretary) (*889*)
De Land, Fred., Electrician, Manager of *Electrical Engineering*, 565, The Rookery, Chicago, Ill.
Delafield, A. Floyd, Ph.D., Electrical Engineer, Noroton, Conn.
*Delany, P. B., Electrical Engineer and Inventor, South Orange, N.J.
Delaware and Atlantic Telegraph and Telephone Company, Philadelphia, Pa. (*3145*)
Delaware Electric and Supply Company, Electrical Engineers, Wilmington, Del.
Delaware Hard Fibre Company, Manufacturers of Electrical Insulating Materials, Wilmington, Del. (*See also* BRITISH DIVISION)
De Lew & Bailey, Electrical Engineers, 213, East Lombard-st, Baltimore, Md.
Deming Automatic Electric Safety System, Makers of Electric Safety Devices for Railways, 12, Waverly-place, New York. (Edward Deming, Manager)
De Mott Motor & Battery Company, Makers of the De Mott Motor, 173, Greenwich-st, and 114, Liberty-st, New York
Denison Electrical Engineering Co, Manufacturers of Dynamos, Motors, and Electrical Supplies, 65, Orange-st, New Haven, Conn.
Denison, Julian F., Electrician and Manager, Denison Electrical Engineering Co., 67, Orange-st, Lake-place, New Haven, Conn.
Denison, Sylvester P., Electrical Engineer and Expert, 143, Centre-st, New York
Dennis, F. L., Electrical Engineer, 2, Commercial-st, New London, Conn.
Denton, James E., Professor of Experimental Mechanics, Stevens Institute of Technology, Hoboken, N.J.
D'Este & Sceley Company, Makers of the Curtis Steam Turbine, Boston, Mass.
Detroit Dynamo Company, Manufacturers of the King Dynamo, 121-125, Champlain-st, Detroit, Mich.
Detroit Electric Manufacturing Company, Manufacturers of Electrical Supplies, 132 to 140, Brush-st, Detroit, Mich.
Detroit Foundry Equipment Company, Makers of Electric Cranes, Detroit, Mich.

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Detroit Motor Company, Electrical Engineers and Makers of Automatic Electric Motors, 1343-1355, Cass-avenue, Detroit, Mich.

Devereux, D. D., Manager of the Western Union Telegraph Company, Duxbury, Mass.

Dewey Electric Heating Company, Makers of Electric Heaters, 501, 502 and 504, Kirk-bldg, Syracuse, N.Y. (E. B. Wyman, General Manager) *(133)*

Dewey Manufacturing Company, Manufacturers of Electrical Appliances, Syracuse, N.Y. (Mark W. Dewey, Consulting Electrician)

Dewson, Edward H., J.P., Electrical Engineer, Railway Department, General Electric Company, 125, Johnson-st, Lynn, Mass.

DIAGO, FREDERICK C., Electrical Contractor and Patent Agent, 30, Oficios-st, P.O. Box 278, Havana, Cuba. (*Electrica Havana, 448*). **See Advt., p. 496**

Patents, Caveats, Trade Marks, Designs, Copyrights, &c., &c., secured throughout the world

Diamond Electric Manufacturing Company, Makers of the "Diamond" Transformer, 606 and 608, South Washington-st, Peoria, Ill.

Diamond Incandescent Lamp Company, Manufactureres of Incandescent Lamps, Denver, Colo.

Diamond Match Company, Manufacturers of the Combination Dynamo and Engine, 41, Whitney-avenue, New Haven, Conn.

Dickerson, E. N., Electrical Engineer, 64, E. 34th-st, New York

Dickerson, Van Dusen & Co, Manufacturers of Bare and Insulated Wire, 31, Cliff-st, New York

Diehl & Co, Makers of the Diehl Electric Fan, 385, Broadway, New York

Diehl, Philip, Electrical Engineer and Inventor, Singer Sewing Machine Company, 508, Morris-avenue, Elizabeth, N.J.

Dieseldorff, W. A., Electrical Engineer, Coban, Guatemala, Central America

D'Infreville, Georges, Electrical Expert and Engineer, 10, Desbrosses-st, New York

Diss, Charles J., Electrical Engineer, 334, Pearl-st, Brooklyn, N.Y.

Doane, S. Everett, Electrical Engineer, General Electric Company, Swampscott, Mass.

Dobbie, Robert S., Consulting Electrical Engineer, 1014, Bergen-st, Hoboken, N.J.

Dodd, Prof. S. T., Electrical Engineer, 907, Prospect-st, Cleveland, O.

Doddridge & Wolfrum, Consulting Engineers, The Rookery, Chicago, Ill.

*Dolbear, A. E., Ph.D., Consulting Electrician, 620, Atlantic-av., Boston, Mass.

Domestic Electric Power and Light Company, Makers of the Hanson Primary Battery, Baltimore, Md.

Donaldson-Macrae Electric Company, Makers of the Donaldson-Macrae Storage Battery, 215, N. Calvert-st, Baltimore, Md.

Donner, Wm. H., Electrical Engineer, Sprague Elevator Company, 114, W. 30th-st, New York

Doolittle, T. B., Electrical Engineer, American Bell Telephone Co, Boston, Mass.

Doremus, Charles A., M.D., Ph.D., Chemist and Physicist, 92, Lexington-avenue, and 59, W. 59, W. 51st-st, New York

Dorman Dynamo Company, Manufacturers of Dynamos and Electrical Supplies, Chicago, Ill.

Doubleday, Mitchell & Co, Dealers in Electrical Apparatus, Electrical Exchange-bldg, 136, Liberty-st, New York

Douglas, F. A. (formerly of Lockport, N.Y.), Electrician and Dealer in Electrical Apparatus and Supplies, 719, Peach-st, Erie, Pa.

Dow, Alex., City Electrical Engineer, Public Lighting Commission, 511, Hammond-bldg, Detroit, Mich.

Dow, J. H., Maker of the "Dow" Compound Steam Turbine, Cleveland, O.

Doyle, John, Electrical Engineer, 14, Ann-st, New York

Drake, Payson & Whittier Electric Company, Dealers in Electrical Supplies, Providence, R.I.

Drayton & Hall, Dealers in Electrical Supplies, 194, First-st, Portland, Ore.

Dresskell, William M., Electrical Engineer and Inventor of the "Dresskell" Motor, Brainerd, Minn.

Dressler, Charles E., Scientific and Electrical Apparatus Maker, 17, Lexington-avenue, New York

Drugman, Leon, M.I.E.E., Société anonyme du Garde Rio, Rio de Janeiro, U. S. of Brazil

Drysdale, Dr. W. A., Consulting Electrical Engineer, Hale-bldg, Philadelphia, Pa.

Dubuque, Turbine & Roller Mill Company, Turbine Makers, Dubuque, Ia.

Du Charme Company, Electric Motors Manufacturers, 96, Lake-st, Chicago, Ill.

Dudley, Charles B., Chemist and Scientific Expert, Pennsylvania R.R. Company, 1219, Twelfth-avenue, Altoona, Pa.

Duncan, Dr. Louis, Electrical Engineer Sprague, Duncan & Hutchinson, Limited, 15, Wall-st, New York

Duncan, T., Electrical Engineer, 400, Broadway, Fort Wayne, Ind.

Dunderdale, Cleaveland F., Electrical Engineer, Agent Westinghouse Electric and Manufacturing Company, 146, Adams-st, Chicago, Ill.

D'Unger Electrical Telephone Manufacturing Company, Manufacturing Electrical and Telephone Engineers, 167, Dearborn-st, Chicago, Ill.

D'Unger, P. H., Telephone Engineer, 497, Brown-ave, Chicago, Ill.

Dunn, Gano S., Electrical Engineer, Crocker-Wheeler Electric Company, Ampère, E. Orange, N. J.; and 223, Central-park West, New York

Dunston, Robert Edward, Electrician, Room 86, Foster-block, Hartford, Conn.

Duplex Electric Company, Limited, Makers of the Duplex Dynamo and Arc and Incandescent Lamps, Corry, Pa.

Durant, Geo. F., Electrical Engineer, 322, Pine-st, St. Louis, Mo.

Durant, Walter N., Electrical Apparatus Manufacturer, 237, Twenty-second-st, Milwaukee, Wis.

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— E —

Eagle Flectric Manufacturing Company, Electrical Engineers, Superior, Wis.

Eastern Electric Cable Company, Makers of the "Clark" Wire, 61-65, Hampshire-st, Boston, Mass.

Eastern Electric Light and Storage Battery Company, Makers of the Sorley Storage Battery, 37, Market-st, Box 406, Lowell, Mass.

Eastern Engineering and Construction Company, Electrical Engineers, 308, Walnut-st, Philadelphia, Pa.

Easton Electric Company, Electrical Engineers, Makers of the C. & P. Automatic Arc and Incandescent Dynamos, Easton Arc Lamp, &c., 643, Kent-avenue, Brooklyn, N.Y. (Alex. Churchward, Electrician)

Eaton, A. K., Storage Battery Manufacturer, 46, Lexington-ave, Brooklyn, N.Y.

Eaton (G. H.) & Co, Manufacturers of Electrical Apparatus, Boston, Mass.

Eckart, W. R., Electrician, Box 1844, San Francisco, Cal.

Eckert, Gen. Thomas T., President Western Union Telegraph Company, 197, Broadway, New York

Economic Electric Manufacturing Company, Electrical Engineers and Manufacturers of Dynamos and Incandescent Lamps, 1, Beacon-st, Boston, Mass.

Eddy Electric Manufacturing Company, Makers of Electric Motors and Dynamos, Windsor, Conn.; and Havemeyer-bldg, New York

Edgerton, E. M., Electrician, 301, Sixty-third-st, Chicago, Ill.

Edgerton, N. H., Maker of the "Ironsides" Motors and Dynamos, 609, Commercial st, Philadelphia, Pa.

*Edison, Thomas Alva, Consulting Electrician, Electrical Engineer and Inventor, Orange, N.J.

Edison Manufacturing Co, Makers of the "Edison" Fan Motor and "Kennelly" Ammeter, Havemeyer-bldg, New York

Edson, Jarvis B., Maker of Edson's Gauge, 87, Liberty-st, New York

Edwards & Co, Electrical Apparatus Makers, Fourth-avenue, and 144th-st, New York

Edwards, C. V., Patent Agent and Expert, 177, Times-bldg, New York; and 79, Corcoran-bldg, Washington, D.C.

Edwards, J. P., Electrical Engineer, 1569, Walton Way, Augusta, Ga.

Edwards (W. S.) Manufacturing Company, Manufacturers of Electric Light Fittings, 21 and 23, East Lake-st, Chicago, Ill.

Eggers, F. F., Dynamo and Motor Manufacturer, 618, Merchant-st, San Francisco, Cal.

Eglin, Wm. C. L., Chief of Electrical Department, Edison Electric Light Company, 909, Walnut-st, Philadelphia, Pa. (*820*)

Eickemeyer-Field Manufacturing Company, Manufacturers of Electric Railway Apparatus, &c., Yonkers, N.Y.

Eimer & Amend, Manufacturers of Electrical and Chemical Apparatus, 205-211, Third-ave, cor. Eighteenth-st, New York

Ekstrom, Axel, Electrician, General Electric Company, Lynn, Mass.

Elbridge Electrical and Manufacturing Company, Makers of the "Eldridge" Dynamo, Elbridge, N.Y.

Electric Appliance Company, Agents for the Paranite Wires and Cables, 242, Madison-st, Chicago, Ill.

Electric Construction Company, Makers of the Elkhart Transformer, Elkhart, Ind.

Electric Construction and Supply Company, Manufacturing Electrical Engineers, 18, Cortlandt-st, New York; and Phœnix-bldg, Chicago, Ill.

Electric Cutter Company, Makers of Electric Cutters, 166, Elm-st, New York

Electric Engineering and Supply Company, Manufacturers of Electrical Machinery and Supplies, Syracuse, N.Y.; and 126, Liberty-st, New York.

Electric Equipment Company, Electrical Engineers and Contractors, 153, St, Clair-st, Cleveland, O.

Electric Fare Box Company, Makers of the Crowdus Universal Battery, 418, Cedar-st, Nashville, Tenn.

Electric Gas Lighting Company, Manufacturers of the Samson Battery and Dealers in Electrical Apparatus, &c., 195, Devonshire-st, and 56, Arch-st, Boston, Mass. (Wm. W. Burnham, General Manager.)

Electric Improvement Manufacturing Company, Manufacturing Electrical Engineers, 139, La Salle-st, Chicago, Ill.

Electric Launch and Navigation Co, Builders of Electric Launches, Camden, N.J.

Electric Manufacturing Company, Manufacturers of Electrical Apparatus, Charlestown, W. Va.

Electric Manufacturing Company, Electrical Apparatus Makers, Troy, N.Y.

Electric Manufacturing Company, Manufacturers of the "Brilliant" Incandescent Lamp, Oconto, Wis.; and 239, La Salle-st, Chicago, Ill.

Electric Motor Company, Manufacturers of Electrical Machinery, Duluth, Minn.

Electric Power (monthly), 36, Cortlandt-st., New New York. European subscription, $3 per annum.

Electric Power and Storage Company, Manufacturers of Storage Batteries, Havemeyer-bldg, New York; and Ashland, Wis.

Electric Railway Engineering Company, Electric Railway Engineers and Contractors, 180, Summer-st, Boston, Mass.

Electric Road Carriage Company, Battery Manufacturers, 101, Milk st, Boston, Mass.

Electric Selector and Signal Company, Manufacturers of Electrical Apparatus, 45, Broadway, New York. (C. P. Mackie, Manager)

Electric Service Company of Buffalo, Electrical Engineers and Manufacturers' Agents, 128, Erie County Savings Bank-bldg, Buffalo, N. Y. (H. W. Watson, President; Samuel Ames, Secretary)

Electric Storage Battery Company, Makers of the Chloride Accumulator, Drexel-bldg, Philadelphia, Pa.

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Electric Supply and Contracting Company, Electrical Engineers and Dealers in Electrical Supplies, Nevada-bldg, cor. Fifth and Sycamore-sts, Cincinnati, O. (*1117*)

Electric Supply Company, Dealers in Electrical Apparatus, Fisher's-lane, Germantown, Philadelphia, Pa.

Electric Supply and Engineering Company, Manufacturers of Electrical Supplies, Detroit, Mich.

Electric Tramway Maintenance Company, Electric Traction Engineers and Contractors, 1, Broadway, New York

Electrical Accumulator Company, Manufacturers of Electrical Accumulators and Storage Batteries, 44, Broadway, New York; and Chicago, Ill. Works: Newark, N.J. (*Ampere New York*)

Electrical Age (weekly), 12-13, World-bldg, New York. (T. R. Taltavall, Editor.) Price $4 per annum. (*Electage New York, 2361 Cortlandt*)

Electrical Carbon Co., Makers of Electric Light Carbons, Detroit, Mich.

Electrical Conduit Traction Equipment Company, Owners of the Griffin Electrical Railway System 94, Wall-st, New York

Electrical Construction Company, Electrical Engineers, 192, Griswold-st, Detroit, Mich.

Electrical Construction and Improvement Company, Manufacturers of the Ironsides Dynamos and Motors, 805, Sansom-st, Philadelphia, Pa.

Electrical Construction and Manufacturing Company, Contractors for Electric Street Railways, 108, N. Eutaw-st, Baltimore, Md.

ELECTRICAL ENGINEER (weekly) [**incorporated**], 203, Broadway, New York. (Geo. M. Phelps, President; T. Commerford Martin and Joseph Wetzler, Editors.) (*Lengineer New York, 3860* Cortlandt) Ann. Sub., P.U., $5.

Electrical Engineering (monthly), 565, The Rookery, Chicago, Ill. (Prof. W. M. Stine, Editor.) (Ann. sub., $3, P.U., $4)

Electrical Engineering Company, Manufacturers of Keith s Dynamos and Motors and Electrical Apparatus, 714, Jones-st, San Francisco, Cal.

Electrical Engineering Company, Dealers in Electrical Supplies, 249, Second Avenue, South Minneapolis, Minn; and at Chicago, Ill.

Electrical Engineers, American Institute of—*see* AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Electrical Fiber Carbon Company, Manufacturers of Batteries, &c., 1228-1234, Michigan-avenue, Chicago, Ill.

Electrical Forging Company, Electric Welders, 163-167, Oliver-st, Boston, Mass.

Electrical Industries (monthly), Monadock-bldg, Chicago, Ill. (Ann. sub., P.U., $4.50 = 19s.)

Electrical Installation Company, Electrical Engineers, 917 and 918, Monadnock-bldg, Chicago, Ill.

Electrical Literature (monthly), 565, The Rookery, Chicago, Ill. (Prof. W. M. Stine, Editor)

Electrical Machine Company, Manufacturers of Electrical Supplies, 1008, Title and Trust-bldg, Chicago, Ill.

Electrical Manufacturing Company, Manufacturers of Electrical Apparatus, 8-10, N. Jefferson-st, Dayton, O.

Electrical Manufacturing and Gas Engine Company, Manufacturers of Electrical Apparatus, Havemeyer-bldg, New York

Electrical and Mechanical Engineering and Trading Company, Manufacturers of Electrical Apparatus, Edison-bldg, 44, Broad-st, New York

Electrical Piano and Motor Company, Makers of the Feldkamp Motor, Newark, N.J.

Electrical Repair Works, Electricians, 327, Washington-st, Buffalo, N.Y.

Electrical Review (weekly), 13, Park-row (P.O. Box 3329), New York. (Charles W. Price, Editor.) Price: America, $3; other countries, $5. (*Elect-riew New York, 546*)

Electrical Specialty Company, Manufacturers of Electrical Supplies, 18 and 20, Cortlandt-st, New York

Electrical Storage Battery Company, Electrical Engineers Allegheny-ave, Philadelphia, Pa.

Electrical and Street Railway Reporter (monthly), 134, Liberty-st, New York. (——Hall, Manager)

Electrical Supply Company, Manufacturers of Electrical Supplies, 328, Bush-st, San Francisco, Cal.

Electrical Supply and Construction Company, Dealers in Electrical Supplies, Bay City, Mich (W. F. Hold, Manager.) (*1160*)

Electrical Supply and Construction Company, Dealers in Electrical Supplies, 947, Liberty-st, Pittsburg, Pa.

ELECTRICAL WORLD, The (weekly), 167-177, Times-bldg, New York. Price $3 per year. Foreign subscription, £1. 5s. post free. (*Electrical New York.*)

Agents in Great Britain for SUBSCRIPTIONS *and* ADVERTISEMENTS: "THE ELECTRICIAN" *Printing and Publishing Company, Limited, 1, 2 and 3, Salisbury-ct, Fleet-st, London, E.C., England*

Electricity (weekly), 6, Park Place, New York; Chicago, Ill; and Boston, Mass. (Ann. sub., P.U., $4.50 = 19s.)

Electricon Metal Company, Manufacturers of Dynamo Castings, &c., 45, Broadway, New York

Electro Chemical and Speciality Company, Manufacturing Electricians, 136, Liberty-st, New York

Electro-Dynamic Company, Manufacturers of the Edco System of Electric Lighting, &c., 224, Chestnut-st, Philadelphia, Pa. (*Edco Philadelphia*)

Electrofonia Franco-Argentina, Owners of the Buenos Ayres-Rosario Telegraph Line, Buenos Ayres

Elektron Manufacturing Company, Electrical Engineers, Springfield, Mass; and 89, Liberty-st, New York. (E. H. Cutler, General Manager; Frank A. Perret, Consulting Electrician; and Edward K. Brown, Electrician)

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Elliott-Lincoln Electric Company, Electrical Engineers and Contractors, 78-80, East Prospect-st, Cleveland, O. (5311)

Ellison, George B., Electrical Engineer (Waddell-Entz Company), 1,140, Monadnock-bldg, Chicago, Ill.

Elson & Brewster Engineering Company, Electrical Engineers, 141, Liberty-st, New York

Elwell-Parker Electric Company of America, Dynamo and Motor Makers, Cleveland, O.

Emerson Electric Manufacturing Company, Manufacturers of Electric Lighting and Railway Specialities and Alternating Current Motors, 1110 and 1112, St. Charles-st, St. Louis, Mo. (H. L. Parker, President; C. R. Meston, Secretary)

Emery, Charles Edward, Consulting Electrical Engineer, 915, Bennett-bldg, cor-Fulton and Nassau-sts, New York

Emmet Bros. & Griswold, Manufacturers of Electric Railway Supplies, 150, Broadway, New York

Empire Electric Company, Makers of the Jewel Incandescent Lamp, 171, S. Canal-st, Chicago, Ill.

Empresa Luz Electrica Cassels, Electrical Engineers and Contractors, Central Station, Barracas al Sud, Buenos Ayres

Enamel Electric Manufacturing Company, Manufacturers of Electrical Machinery, E. Orange, N.J.

Engineering Equipment Company, Dealers in Electrical Machinery, Belting, &c., Central Building, 143, Liberty-st., New York

"ENGINEERING MAGAZINE" (monthly), Times-bldg, Printing House-sq, New York, U.S.A. *An American monthly periodical having an extensive sale, and containing popularly written critical articles on Electrical, Engineering, and Social Subjects by leading writers. Agent for the European Edition: Geo. Tucker, Publisher, "The Electrician" Printing and Publishing Company, Limited, Salisbury Court, Fleet-st, London, E.C.* (Ann. Sub. 12s. 6d. post free, abroad 14s.)

Engineering and Mining Journal (weekly), The Scientific Publishing Company, 27, Park place, New York. Price $4 (P.U. $5) per annum. (*See also* BRITISH DIVISION)

Enterprise Construction and Supply Company, Limited, Manufacturers of Electrical Machinery and Supplies, 169, Gravier-st, New Orleans, La.

Enterprise Electric Company, Electrical Engineers and Contractors, 307, Dearborn-st, Chicago, Ill.; and 15, North Ninth-st, St. Louis, Mo.

Entrekin-Elder Electric Company, Manufacturers of Electric Heating Apparatus, Harrisburg, Pa.

Entz, Justus B., Electrical Engineer, Waddell-Entz Electric Company, Bridgeport, Conn.

Equitable Dynamo Company, Dynamo Makers, Chicago, Ill.

Ericson, E. C., Electrical Engineer, P.O., Box 534, Chicago, Ill.

Erie Machinery Supply Company, Makers of Electric Motors, Erie, Pa.

Esperson (A. F.) Company, Manufacturers of Electrical Apparatus, P.O. Box 1106, and 112, Tenth-st, Tacoma, Wash.

Essick Printing Telegraph Company, 171, Broadway, New York. (Samuel V. Essick, Electrician)

Euclid Avenue Electric Company, Electrical Engineers, 1144, Euclid-ave, Cleveland, O.

Eureka Electric Company, Manufacturers of the Loomis System of Incandescent Electric Lighting, 18, Broadway, New York

Eustis, Herbert H., Electrician, Eastern Electric Cable Company, 61, Hampshire-st, Boston, Mass.

Evans (D. E.) & Co, Consulting Electrical Engineers, 10, S. Gay-st, Baltimore, Md.

Everest, Augustine R., Electrical Expert, Thomson Electric Welding Company, Lynn, Mass

Excelsior Electric Company, Electrical Engineers and Makers of Electric Motors, &c., 44, Broad-st, New York; and 425, The Rookery, Chicago, Ill. (William Hochhausen, Electrician)

— F —

Facer (Wilson E.) & Co, Manufacturers of Electrical Apparatus, 145, Bank-st, Cleveland, O.

Falconer Manufacturing Company, Manufacturers of Electrical Apparatus, 1, Hartford-st, Boston, Mass.

Falls City Electric Company, Manufacturers of the "Hanson" Primary Battery, Louisville, Ky.

Farnham, Isaiah H., Electrician, New England Telephone and Telegraph Company, 125, Milk-st, Boston, Mass.

Fay (J. A.) & Egan Company, Makers of Electric Cranes and Lifts, Cincinnati, O.

Fay, Thomas J., Electrical Engineer, 16, St. Lukes-st, New York

Fehr Electric and Manufacturing Company, Manufacturers and Repairers of Electrical Machinery, Hoboken, N.J.

Fell, Otto, Superintendent, Western and Brazilian Telegraph Company, Pernambuco, Brazil.

Fessenden, Reginald A., Professor of Electrical Engineering, Western University of Pennsylvania, Allegheny, Pa.

Fibre Conduit Company, Manufacturers of Underground Electric Light Conduits, 45, Broadway, New York

Field Engineering Company, Consulting and Constructing Engineers for Electric Railways, Power Transmission and Electric Light Installations, 143, Liberty-st, New York. (C. J. Field, Manager)

Field, Stephen D., Electrician and Inventor, Stockbridge, Mass.

Fish, E. H., Electrical Engineer, H. C. Fish Machine Works, 152, Union-st, Worcester, Mass.

Fish (H. C.) Machine Works, Dynamo Makers, 152, Union-st, Worcester, Mass. (E. H. Fish, Electrical Engineer)

Fisher Electric Company, Electrical Engineers and Apparatus Makers, 183-187, Larned-st, Detroit, Mich.

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Fisher, Geo. E., Electrical Engineer and Manager, Commercial Electric Company, 55-57, Gratiot-avenue, Detroit, Mich.

Fiske, Henry G., Electrician, Croton Magnetic Iron Mines, 45, East Twenty-Second-st, New York

Fiske, J. P. B., Electrical Engineer, General Electric Company, Lynn, Mass.

Fitch, D. H., Electrical Engineer and President, Bee Hive Electric Works, Cazenovia, N.Y.

Fitch Excelsior Switch Company, Makers of the Fitch Switch, 45, Broadway, New York

Fitchburg Steam Engine Company, Makers of the Fitchburg Steam Engines, Boston, and Fitchburg, Mass.

Fitts (Frank E.) Manufacturing and Supply Company, Dealers in Electrical Supplies, Boston, Mass. (*Fifth Boston, 721.*)

Flack, J. Day, Superintendent of Equipment, General Electric Co's Lamp Works, Harrison, N.J.

Flanders, L. H., Electrical Engineer and Machinest, 1025, Hamilton-st, Philadelphia, Pa.

Flather, John J., Professor of Mechanical Engineering, Pardue University, Lafayette, Ind.

Fleming (W. R.) and Co, Electric Light Engineers and Contractors, 203, Broadway, New York. (*3896 Cortlandt*)

Fleming, R., Electrical Engineer, Rockford Electric Manufacturing Company, Rockford, Ill.

Fleming, Wilfrid H., Electrical Engineer, Trask-avenue, Bayonne City, N.J.; and Times-bldg, New York. (*Wassail New York*)

Fletcher and Fletcher Electric Company, Manufacturers of Electrical Supplies, 9, South-Water-st. Cleveland, Ohio

Flood, J. F., Electrician, Superintendent Street Railway Company, Steubenville, Ohio. (*45*)

Flood, Samuel D., Electrical Engineer, Mining Department, General Electric Company, 173, Adams-st, Chicago, Ill.

Fontaine Crossing Company, Makers of the "Fuller" Dynamo, Detroit, Mich.

Foote, Allen R., Special Agent, Electrical Industries, Eleventh U.S. Census, Takoma Park, D.C.

Foote, Charles W., Electrician, 702, Society for Savings-bldg, Cleveland, O.

Forbes, Francis, Electrical Expert, 137, Broadway, New York. (*Zugginger New York*)

*Forbes, Prof. George, Consulting Electrical Engineer, 106, Mills-bldg, 35, Wall-st, New York

Ford, Wm. S., Assistant Engineer and Electrician, American Bell Telephone Company, 125, Milk-st, Boston, Mass.

Ford-Washburn Storelectro Company, Manufacturers of Electric Motors and Dynamos, Cleveland, Ohio, and 206, Temple-court-bldg, Chicago, Ill.

Forstall, W., Electrical Engineer, 116, East 55th-st, New York

Fort Wayne Electric Company, Manufacturing Electrical Engineers, Fort Wayne, Ind.

Foster, Horatio A., Electrical Engineer, Mills-bldg, 35, Wall-st, New York

Foster, O. A., Maker of the "1891" Motors and Batteries, 8, Oliver-st, Boston, Mass.

Fottrell Insulated Wire Company, Manufacturers of Insulated Wire and Cables, Philadelphia, Pa.

Fowler, Fred. C., Mechanician, Department of Physics, Cornell University, Ithaca, N.Y.

Fowler, W. F., Electrical Engineer, 620, Atlantic-ave, Boston, Mass.

Fox, John M., Electrical Engineer and Contractor, 73, Union-st, Portland, Me.

Frame, Asa B., Maker of Frame's Water Wheel, Boyden, Ia.

Francis, J. G., Manufacturers of Electrical Apparatus, 100, Greenwich-st, New York

Francisco, M. J., Electrician, President and General Manager, Rutland Electric Light Company, 49, Merchants'-row, Rutland, Vt.

Franklin Electric Appliance Company, Manufacturers of Electrical Apparatus, Boston, Mass.

Franklin Electric Company, Makers of Franklin Accumulators, 136, Liberty-st, New York

Franklin Electric Company, Manufacturers of Electrical Supplies and Apparatus, 120, Randolph-st, Chicago, Ill.

Franklin Institute of the State of Pennsylvania for the Promotion of Mechanical Arts, 15, South Seventh-st, Philadelphia, Pa.
E. G. Willyoung, President.. of Electrical
R. H. Laird, Secretary .. Section

Franklin-Morse Electrical and Mechanical Manufacturing Company, Manufacturers of Electrical Appliances, East St. Louis, Ill.

Fraser, W. J., Superintendent, Direct United States Cable Company, Old State House, Boston, Mass.

Freedman, William H., Electrical Engineer, 120, West 125th-st, New York

Freeman, Colman & Co, Electrical Engineers and Experts, 53 and 55, South Jefferson-st, Chicago, Ill.

Freeman, Dr. Frank L., Electrical and Patent Expert, 931, F-st, Washington, D.C. (*Retsof Washington, 224*)

Freeman, Walter K., Electrician, 53, State-st, Boston, Mass.

French, E. L., Electrical Engineer, Stanley Laboratory Company, Pittsfield, Mass.

French, Hollis, Electrical Engineer, Massachusets Electrical Engineering Company, 4, Post Office-sq, Boston, Mass. (*Yesfrench Boston, 873*)

Frey, C. P., Chief Electrician to the E. S. Greeley Company, 5—7, Dey-st, New York; and Greenbush, N.Y.

Frink, I. P., Maker of Electric Light Reflectors, 551, Pearl-st, New York

Frisbie Elevator and Manufacturing Company, Manufacturers of Electric Cranes, &c., New Haven, Conn.; and Mail and Express-bldg, New York

Fuller, Levi K., Electrical Engineer, Estey Organ Company, Brattleboro, Vt.

—— G ——

Gale, Horace B., Consulting Electrical and Mechanical Engineer, 40, California-st, San Francisco, Cal.

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Galvano-Faradic Manufacturing Company, Makers of the Fitch Perfect Battery, 300, Fourth-avenue, New York

Gardam (William) & Son, Manufacturing Electricians, 98, John-st, New York

Gardiner, J. T., Consulting Electrical and Mechanical Engineer, St. Joseph, Mo.

Garrett Electrical Machine Works, Electrical Engineers, 474, Live Oak-st, Dallas, Texas

Garton Daniels Electric Company, Manufacturers of Lightning Arrestors, Keokuk, Ia.

Gaston Electrical Manufacturing Company, Manufacturers of Electrical Supplies and Machinery, Sparta, Ill.

Gaston, Weston & Ladd, Electrical Engineers, 15, Murray-st, New York

Gate City Electric Company, Dealers in Electrical Supplies, 522, Delaware-st, Kansas City, Mo.

Gates, J. Holt, Electrical Engineer, Western Manager of the Waddell Entz Co, 1122, Monadnock-bldg, Chicago, Ill.

Gault (N. C.) & Co, Electrical Engineers, Winona, Minn.

Gem City Manufacturing Company, Limited, Makers of Electric Fan Motors, Erie, Pa. (J. G. Moody, Electrician)

General Electric Company (Edison and Thomson-Houston Systems), 620, Atlantic-avenue, Boston, Mass.; 44, Broad-st, New York (*Hydsum New York*); and at Chicago, Ill.; Philadelphia, Pa., &c. Factories: Schenectady, N.Y. (Edison); and Lynn, Mass. (Thomson-Houston)

General Electric Launch Company, Electric Launch Builders, 44, Broad-st, New York (*Electraunch New York, 3644*)

General Incandescent Arc Lamp Company, Manufacturers of Arc and Incandescent Lamps, 572-575, First-avenue, New York (*163*); and at Chicago, Ill.

General Manufacturing Company, Electrical Engineers, Bound Brook, N.J.

Gerson, Louis J., Electrical and Mechanical Engineer, 4303, Walnut-st, Philadelphia, Pa.

Gesner, John F., Consulting Electrician and Chemist, 21, State-st, New York

Gethins Electrical Manufacturing Company, Makers of the Gethins Gravity Battery, 620, Atlantic-avenue, Boston, Mass.

Geyer, Prof. W. E., Consulting Electrician, Stevens Institute of Technology, Hoboken, N.J.

Ghegan, J. J., Consulting Electrician, 210, Garside-st, Newark, N.J.

Gibbs, Lucius T., Electrical Engineer, 1103, Pabst-bldg, Milwaukee, Wis.

Giles, W. A., Electrical Engineer, and Contractor, 416, Lewis-block, Pittsburgh, Pa.

Gill (Alexander) Electric Manufacturing Company, Manufacturers of Electrical Apparatus, Gibraltar-bldg, Kansas City, Mo.

Gillett Electric Company, Manufacturers of Electrical Specialities, Red Bank, N.J.

Gilliland, E. T., Electrician, P.O. Box 56, Pelham Manor, N.Y.

Gleason & Bailey Manufacturing Company, Limited, Manufacturers of Electrical Supplies, 233, Lake-st, Chicago, Ill.

Gleason (E.P.) Manufacturing Company, Manufacturers of Electric Light Fittings, 181-189, Mercer-st, New York

Gleeson (T. W.) & Co, Manufacturers of Electrical Supplies, 62, Sudbury-st, Boston, Mass.

Glenny (W. H.), Sons & Co, Manufacturers of Electric Light Fittings, 251-257, Main-st, Buffalo, N.Y.

Globe Carbon Company, Makers of High-Grade Carbons for Electric Lighting, Ravenna, O.

Globe Storage Battery Company, Manufacturers of Storage Batteries, Chicago, Ill.

Glover Electric Company, Dealers in Electrical Supplies, 127, West Eighth-st, Cincinnati, O.

Goldmark, Charles J., Electrical Engineer, Field Engineering Co, 143, Liberty-st, and 473, Park-avenue, New York

Goode, A. H., Electrical Engineer, 932, Monadnock-bldg, Chicago, Ill.

Goodhue & Lincoln, Dealers in Electric Supplies, 1564, Monadnock-bldg, Chicago, Ill.

Gooding, Beinert & Co, Manufacturers of Electrical Appliances, 126, Elm-st, New York

Goodrich-Coleman Electrical Works, Manufacturers of Electrical Appliances, 31, South Canal-st, Chicago, Ill.

Gordon (W. H.) & Co, Electric Light and Power Engineers, 115, Broadway, New York

Gorton, Charles, Civil and Electrical Engineer, Belmont, N.Y.

Goulds Manufacturing Company, Makers of the Goulds Electric Power Pumps, 16, Murray-st, New York; and Seneca Falls, N.Y.

Granite State Electric and Machine Company, Makers of the Cushman Dynamo and Motor, 36, South Main-st, Concord, N.H.

Graton & Knight Manufacturing Company, Manufacturers of Electric Apparatus, Worcester, Mass.

Graves Elevator Company, Manufacturers of Electric Cranes, Rochester, N.Y.

Graves, John T., Electrical Engineer, 224, Eighth-st, Miennapolis, Minn.

Graves (W. D.) Electric and Machine Works, Manufacturers of Electrical Apparatus, 8, Case-place, and 6-12, Rockwell-st, Cleveland, O.

Gray Electric Company, Manufacturers of the Telantograph, 80, Broadway, New York.

*Gray, Dr. Elisha, Consulting Electrician, Highland Park, Ill.

Gray, T., F.R.S.E., Consulting Electrician, Professor of Dynamics and Electrical Engineering, Rose Polytechnic Institute, Terre Haute, Ind.

Gray, W. N., Electrical Engineer, 200, Neave-bldg, Cincinnati, O.

Gray's Dynamo and Electric Machine Company, Dynamo Makers, 15, Chardon-st, Boston, Mass.

Great Western Manufacturing Company, Manufacturers of Electrical Supplies, 195-207, S. Canal-st, Chicago, Ill. Factory, Duluth, Minn. (Foree Bain, Manager)

Greeley (E. S.) Co, Manufacturers of Telegraph, Telephone and General Electrical Supplies, 5 and 7, Dey-st, New York

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Green Electric Lamp Company, Makers of the "Green" Incandescent Lamp, Hartford, Conn.

Green, Geo. A., Electrician and Telegraph Engineer, Anglo-American Telegraph Company, Duxbury, Mass.

Green, H., Electrical Engineer and Inventor of the "Green" Incandescent Lamp, 160, Sisson-avenue, Hartford, Conn.

Greene, S. Dana, Electrical Engineer and Assistant General Manager, General Electric Company, 44, Broad-st, New York

Greensfelder, Lewis S., Vice-President, Ries Electric Speciality Company (Incorporated) 7, South Gay-st, Baltimore, Md.

Gregory, (Chas. E.) & Co, Dealers in Electrical Machinery, 27-29, S Jefferson st, Chicago, Ill.

Greiner, Emil, Manufacturer and Importer of Electrical Apparatus and Technical Instruments, 146-148, William-st, New York

Grier, Edward R., Electrical Engineer, 501, Girard-bldg, Philadelphia, Pa.

Grier, Dr. M. J., Electrician, 1531, Spruce-st, Philadelphia, Pa.

Griffith (W. S.) & Co., Electric Light Engineers 114, South Fifteenth-st, Philadelphia, Pa.

Grill, Enrique, Electrician, 177, Calle Suipacha, Beunos Ayres

Grimes Bros., Electrical Engineers and Contractors, 807, Main-st, Kansas City, Mo.

Grove, Carlos, Dealer in Electric Supplies, 183, Calle Zebala, Monte Video, Uruguay

Grower, G. G., Electrician, Ansonia Brass and Copper Company, Ansonia, Conn.

Guillaume, Alfred, Electrical and Mining Engineer, 215, Dearborn-st, Chicago, Ill.

Guillaume-Johnston Electric Company, Manufacturing Electrical Engineers, Owningsbldg, Chicago, Ill. (*111 Main*)

Gutmann, Ludwig, Electrical Engineer, c/o Edward P. Thompson, 5, Beckman-st, New York

Guy, George Hall, Electrician, New York Electrical Society, 533, Temple-court, New York

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H. and H. Electric Manufacturing Company, Dynamo and Motor Makers, 136, Liberty-st, New York; and 22 and 24, Morris-st, Jersey City, N.J.

Haskenthal, W., Maker of Electric Meters, 21, Beekman-st. New York

Hale Elevator Company, Makers of Electrical Elevators, 189, La Salle-street, Chicago, Ill.

Hall, Clayton C., C.E., Electrical Engineer, 810, Park-avenue, Baltimore, Md.

Hall, Edwin H., Assistant Professor of Physics, Harvard College, Gorham-st, Cambridge, Mass.

Hall, J. P., Electrical and Mechanical Engineer, 235, Central-bldg, 143, Liberty-st, New York

Hall Signal Company, Manufacturers of Electric Signals, &c., 80, Broadway, New York; and Chicago, Ill.

Hill, W. H., Electrical Engineer and Professor of Electricity, Baltimore Polytechnic Institute, Baltimore, Md.

Halsey, Wm B., Electrician, Postal Telegraph Cable Company, 94, Leonard-st, New York

Hamilton, F. A., Electrical Engineer, P.O. Box 708, Chicago, Ill.

Hamilton, George A., Consulting Electrician, Western Electric Company, 22, Thames-st, New York; and 532, Morris-avenue, Elizabeth, N.J.

Hamilton, William H., Electrical Engineer, 677, Dayton-avenue, St. Paul, Minn.

Hammer, W. J., Consulting and Supervising Electrical Engineer, 1301 and 1302, Havemeyer-bldg, 26, Cortland-st, New York. (*Remmah New York*)

Hancock, L. M., Electrician and Superintendent of Construction, Western Electric Company, 22, Thames-st, New York

Handley, F. L., Electrician, Room 6, Baron Block, Watertown, N.Y.

Hanson & Van Winkle Company, Manufacturers of Dynamos, Acids, &c., 81, Liberty-st, New York; 219-221, Market-st, Newark, N.J.; and Chicago, Ill.

Harbert (E. E.) & Co, Electrical Engineers, 132, W. Van Buren-st, Chicago, Ill.

Harding, E. R., Dealer in Electrical Machinery, The Rookery, Chicago, Ill.

Harding, C. K., Electrician and Inventor, Atlantic Ia.

Harding, H. McL., Electrical Light and Power Engineer. 1014, Havemeyer-bdg, 26, Cortlandt-st, New York

Harnish, T. C. Electrical Engineer and Agent, Cincinnati, O.

Harrington, Walter E., Consulting Electric Railway Engineer, 307, Market-st, Camden, N.J.

Harris, Chas. O., Electrical Engineer, Memphis Light & Power Company, Memphis, Texas

Harris-Woodruff Electrical Company, Electrical Engineers, Birmingham, Ala.

Harrison & Carey, Dealers in Electrical Supplies, 801 & 802, Monadnock-bldg, Chicago, Ill

Harrison International Telephone Company, Telephone Contractors and Engineers, Chicago Ill.

Harrison Safety Boiler Works, Boiler Makers Germantown Junction, Philadelphia, Pa.

Harrison (W. P.) & Co, Makers of the "Home" Electric Motor, Columbus, O.

Hart, Francis R., Electrical and Mechanical Engineer, 50, State-st, Boston, Mass., Jamaica, West India and Cartagena, South America (*Electreng Boston*)

Hart & Hegeman Manufacturing Company, Makers of the "Hart" Switch and Electrical Supplies, 190, Pearl-st, Hartford, Conn.

Hart, W. J., City Electrical Expert, Saginaw, Mich.

*Haskins, Caryl D., Electrical Engineer and and Manager of the Meter Department General Electric Company, 620, Atlantic-avenue, Boston, Mass.

Haskins, Charles H., Electrician, 80, Broadway, New York (*2444 Cortlandt*)

Hasson, Wm. F. C., Consulting Electrical Engineer, 104, Sutter-st, San Francisco, Cal.

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Haskins, C. C., Electric Light Inspector of Chicago City, 582, W. Congress-st, Chicago, Ill.

Hatch Bros, Electrical Engineers and Contractors, Detroit, Mich.

Hatton, (L. D.) & Co, Manufacturers of Electric Light Fittings, Cor. Greene & W. 4th sts, New York, *(Enfecoff New York)*

Hathaway (A. G.) & Robinson, Electrical Engineers and Contractors, Cleveland, O.

Hatzell, J. C., Electrical Engineer and Contractor, 114, Fifth-avenue, New York

Hauss, D. J., Electrical Engineer, 51, Pike-bldg, Cincinnati, O.

Haupt & Co, Dealers in Electrical Apparatus, 53, rua Alfandega, Rio de Janeiro, Brazil

Hawkeye Electric Manufacturing Company, Electrical Engineers and Makers of the Hawkeye Electric Motor, Davenport, Iowa

Hawks Electric Company, Electrical Engineers, 174, Summer-st, Boston, Mass.

Haynes (G. D.) & Co, Manufacturers of Electric Lighting Apparatus and Supplies, 149 and 355, Congress-st, Boston, Mass.

Hays (J. L.) & Co, Manufacturers of Switches, &c, 830, Liberty-avenue, Pittsburgh, Pa.

Hazard Manufacturing Company, Wire and Cable Manufacturers, Wilkes Barre, Pa.

Healy, Louis W., Electrical Engineer, Wightman Electric Company, 1,205, Marion-st, Scranton, Pa.

Hearn, R., Superintendent Commercial Cable Company, Rockport, Mass.

Heath Electric Company, Manufacturers of Electrical Appliances, 324, Grand River-avenue, Detroit, Mich.

Hecla Electric Light Company, Electric Light Engineers, 264, E. 42nd-st, New York

Heinel (Chas.) & Co, Manufacturers of Electric Motors and Commutators, Front and Market-sts, Wilmington, Del.

Heinrich, Richard O., Electrical Engineer, Weston Electrical Instrument Co, 114, William-st, Newark, N.J.

Heinze Electric Company, Manufacturers of Electrical Apparatus, 658, Washington-st, Lynn, Mass.

Helios Electric Company, Makers of the Helios Arc Lamp, 1306-1310, Filbert-st, Philadelpia, Pa. *(Helios Philadelphia)*

Hemans (Henry) & Co, Colonial Engineers and Machinery Agents, 56, Calle San Martin, Buenos Ayres

Henshaw, F. V., Electrical Engineer, C. and C. Electric Company (Inuorporated), 143, Liberty-st, New York

Hercules Electric Company, Makers of the Hercules Primary Batteries, 22, Custom House-pl, Chicago, Ill.

*Hering, Carl, Consulting Electrical Engineer, 927, Chestnut-st, Philadelphia, Pa.

Hering, Hermann S., M.E., Johns Hopkins University, Baltimore, Md.

Hero Electric Company, Electrical Engineers, 78 and 80, Cortlandt-st, New York

Herzog Telescope Company, 30, Broad-st, New York. (F. Benedict Herzog, Ph.D., President and Manager)

Hess Electrical Company, Electrical Engineers, Des Moines, Iowa

Hess, G. Emil, Electrical & Mechanical Engineer, 30, Broadway New York

Hewitt, Charles, Electrical Engineer, Inspector of the Railway Department, General Electric Company, 44, Broad-st, New York

Hewitt (F. A.) & Co, Manufacturers of Electrical Specialities, South Water-st, Cleveland, O.

Hewlett, Edward M., Electrical Engineer (Railway Department), General Electric Company, 128, Johnson-st, Lynn, Mass.

Heynemann, Carlos, Electrical Engineer, Avenida de la Republica, Buenos Ayres, Argentine Republic

Hibbard, W. H., Manufacturer of Electrical Specialites, 45, York-st, Brooklyn, N.Y.

Higgins Gravity Motor & Electric Gravity Clock Company, Battery Makers, Chicago, Ill.

High-Rock Battery and Novelty Company, Makers of the High-Rock Primary Bat- 431, Shawmut-ave, Boston Mass.

Higham Electrical Co. Electrical Engineers, tery, 63, High Rock-st, Lynn, Mass.

Highland Park Normal College, Des Moines, Iowa. (E. C. Sickles, Professor of Electrical Engineering)

Hill Clutch Works, Electrical Engineers and Contractors, Cleveland, Ohio; and at New York; Chicago, Ill., &c.

Hill, George, Consulting Electrical Engineer, 44 and 46, Broadway, New York.

Hill Manufacturing Company, Manufacturers of Transformers and Repairers of Electrical Machinery, Salem, Va.

Hill (W. S.), Electric Company, Makers of Dynamos, Motors, and Electrical Apparatus, 133, Oliver-st, Boston, Mass.

Himmer & Anderson Dry Battery Company, Manufacturers of Electric Clocks, Batteries, Motors, &c., 123, Chambers-st, New York. (Vitalis Himmer, General Manager)

Hinds, Charles H., Maker of Electric Gas Lighters, Trio-bldg, Thirteenth and Hudson-sts, New York

Hirlimann, C. J., Maker of the Champion Primary Battery, 117, Macdougal-st, New York

Hochhausen, Wm., Electrician, Excelsior Electric Company, 196, Willoughby-st, Brooklyn, N.Y.

Hoefer, Ernest, Dealer in Electrical Supplies, 1222, Monadnock-bldg, Chicago, Ill.

Hoenack, Paul, Electrical Engineer, 191 and 193, Worth-st, New York

Hoffman (Frank) & Co, Electrical Engineers, 94, La Salle-st, Chicago, Ill.

Holding, E. G., Electrical Engineer and Contractor, 49, West First South-st, P.O. Box 1318, Salt Lake City, Utah

Hollerith, Dr. Herman, Electrical Engineer and Inventor, Washington, D.C.

Hollings (R.) & Co, Manufacturers of Electrical Apparatus, 525, Washington-st, Boston, Mass.

Holman (F.) Electric Co, Manufacturers of Electric Light Fittings, 128, Pearl-st, New York.

Holman, Silas W., Professor of Physics, Massachusetts Instititute of Technology, Boston, Mass.

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Hood (Wm.) & Co, Electrical Engineers, Makers of the "Jewel" Incandescent Lamp, 239, La Salle st, Chicago, Ill.

Homer (F. E.) & Co, Manufacturers of Dynamos & Motors, 46, S. Water-st, Cleveland, O.

Hope Electric Appliance Company, Manufacturing Electricians, Providence, R.I.

Hopedale Electric Company, Manufacturers of the Usher Storage Battery, Dynamos, Motors, &c., Boston, Mass.

Hopkins, J. H., Electrical Engineer, 403, North Eighth-st, St. Louis, Mo.

Horn (C. E.) & Co, Manufacturers of Electric Machinery and Tools, 18 to 30, Randolph-st, Chicago, Ill.

Hornberger Electric Manufacturing Company, Manufacturers of Electrical Apparatus, Elkhart, Ind.

Hornell Iron Works, Makers of the Storey Motor, Hornellsville, N.Y.

Hosford, Henry H., Electrical Engineer, Professor of Physics, Doane College, Crete, Neb.

*Houston, Prof. Edwin J., Consulting Electrical Engineer, 1809, Spring Garden-st, Philadelphia, Pa. (President of the American Institute of Electrical Engineers) (*Volta Philadelphia*)

Howard, F. N., Electrical Engineer & Agent, 23, Rialto-bldg, Chicago, Ill.

Howard (Hiram M.) & Co, Electrical Engineers, 137, West Second st, Cincinnati, O.

Howe Electric Construction Company, Electrical Engineers, Norwalk, Ohio

Howe, J., M.I.E.E., Telegraph Engineer, Brazilian Submarine Telegraph Company, Pernambuco

Howell, John W., Electrician, General Electric Company's Lamp Works, Harrison, N.J.

Howell, Wilson S., Electrical Expert, Incandescent Lamp Department, General Electric Company, 44, Broad-st, New York; and 19, Webster-place, Orange, N.J.

Hubbard, Norman, Maker of the Packard Vacuum Pump, 93-97, Pearl-st, Brooklyn, N.Y.

Hubbard (Wm.) & Co, Electricians, 94, La Salle-st, Chicago, Ill.

Hubbard, W. C., Consulting Electrician, 136, Liberty-st, New York

Hubbell Portable Electric Lamp and Power Company, Makers of the "Hubbell" Portable Electric Lamp and Battery, 116, Bedford-st, Boston, Mass.

Hubley Manufacturing Company, Manufacturers of Electrical Apparatus, Lancaster, Pa.

Huebel & Manger, Electrical Engineers, 286-290, Graham-st, Brooklyn, N.Y.

Hughes Bros. Manufacturing Company, Manufacturers of Electrical Apparatus, Chattanooga, Tenn.

Humphrey Manufacturing Company, Manufacturers of Electrical Apparatus, 33, South Canal-st, Chicago, Ill.

Hunger (C. F.) Company, Manufacturers of Electrical Apparatus, Cleveland, O.

Hunt (C. W.) Company, Electrical Engineers, 45, Broadway, New York

Hunt Engineering Company, Electrical Engineers, 126, Liberty-st, New York.

Hunt (Rodney) Machine Company, Manufacturers of Turbine Water Wheels, Orange, and 70, Kilby-st, Boston, Mass.

Hunter (J. F.) & Co, Electrical Engineers, 33, Church-st, New York

Hunter, Rudolph M., Mechanical and Electrical Engineer, 926, Walnut-st, Philadelphia, Pa.

Hunter (T. F.) & Co, Manufacturers of Electrical Supplies, 37, Church-st, New York

Hurd, Ligget & Cooper, Electricians and Machinists, 212, Griswold-st, Detroit, Mich.

Hussey Battery Company, Manufacturers of Storage Batteries, 144, Greenwich-st, New York

Hussey & Co, Manufacturing Electricians, 211-213, Randolph-st, Chicago, Ill.

Hutchinson, Cary T., Ph.D., Electrical Engineer, Sprague, Duncan and Hutchinson, Limited, 15, Wall-st, and 640, Madison-ave, New York

Huyett and Smith Manufacturing Company, Makers of the "Smith" Ventilating Fan and Motor, Detriot, Mich.; and at New York; Chicago, Ill.; and Boston, Mass. (*Ventilator Detroit*)

H. W. JOHNS MANUFACTURING CO, 87, Maiden-lane, New York City, U.S.A. (Cable Address: *Wardjohns New York*)

Manufacturers of Insulating Materials for all Electrical purposes; Asbestos Paints and Building Materials, Steam Pipe and Boiler Coverings, Steam Packings, Asbestos Fabrics, Cements, &c., &c.

Hyde, Jerome W., Electrical Engineer, 36, Taylor-st, Springfield, Mass.

Hyer-Sheehan Electric Motor Company, Makers of the Hyer-Sheehan Motor, Stafford Springs, Conn.; and Newburg, N.Y.

Hyland, Huggins, Hammond & Co, Electrical Engineers and Contractors, Caiya 291, São Bulo, Brazil

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Idell, F. E., Consulting Engineer, 616, Havemeyer-bldg, cor. Cortlandt and Church-sts. New York (*881 Cortlandt*)

Ihlder, John D., Electrical Engineer, c/o Eickemeyer-Field Manufacturing Company, Yonkers, N.Y.

Imperial Electric Company, Makers of the Imperial Porcelain Sockets, 1,218, and 1,220, Filbert-st, Philadelphia, Pa.

Independent Electric Company, Manufacturers of Electrical Apparatus, 39th-st and Stewart-ave, Chicago, Ill

India Rubber and Gutta Percha Insulating Company, Manufacturers of Insulated Wires and Cables, 315, Madison-avenue, New York. Factory: Glenwood, Yonkers

India Rubber World and Electrical Trades Review (monthly), 192, World-bldg, New York. (Ann. sub., P.U., $3 = 12s. 6d.)

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Indiana Rubber and Insulated Wire Company, Manufacturers of Paranite Insulated Wires and Cables, Marion, Ind.

ngersoll (Robert H.) & Bros. Makers of the "Dolmar" Motor, 65, Cortlandt-st, New York

Ingersoll-Sergeant Drill Company, Makers of the Crescent Battery for Electric Blasting, 10, Park-pl, New York.

Inman Brothers Construction Company, Electrical Engineers, 136, Liberty-st, New York

Insull, Samuel, Electrical Engineer, President, Chicago Edison Company, 139, Adams-st, Chicago, Ill.

Interior Conduit and Insulation Company, Manufacturers of the Lundell Motor and Underground Conduits, Edison-bldg, 42 and 44, Broad-st, New York.

Interior Telephone Company (Colvin System), 203, Broadway, New York. (F. R. Colvin, President.) (*3860 Cortlandt*)

nterior Wiring and Fixture Company, Contractors for Wiring of Buildings, 14, Clinton-pl, New York

International Bell Telephone Company, Limited, New York

International Electric Supply and Construction Company, Dealers in Electrical Supplies, San Francisco, Cal.

International Storage Battery Company, Makers of Woodward's Tubular Secondary Battery, Detroit, Mich.

International Trading and Electric Company, Dealers in Electrical Supplies, 40, Cortandt-st, New York. (W. H. Fleming, General Manager.) (*Wasaii New York*)

Interstate Complete Electric Construction Company, Manufacturers of Electrical Apparatus, 809-817, South Seventh-st, St. Louis, Mo.

Iona Manufacturing Company, Manufacturers of Electrical Supplies, 336, Congress-st, Boston, Mass. (Norman Marshall, Manager; H. M. Nicholls, Secretary)

owa Electric and Construction Company, Electrical Engineers, 808, Walnut-st, Des Moines, Iowa

Irish, W. E., Manufacturer of Arc Lamps and Electrical Apparatus, 48-50, Long-st, Cleveland, Ohio

Isham, A. D., Manufacturer of Electrical Apparatus, P.O. Box 171, Buffalo, N.Y.

Issertel, Henry G., Dealer in Electrical Supplies, 39, Cortlandt-st, New York

Ives, Lieut. E. B., Electrical Engineer, 11th and Colono-streets, and Grand Boulevard, New York

Izard, E. M., Electrical Engineer, Room 1413, Ashland Block, Chicago, Ill.

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Jackson, J. P., Electrician and Assist. Prof. of Electrical Engineering, Penn. State College, State College, Pa.

Jackson and Sharpe Company, Manufacturers of Electrical Apparatus, Wilmington, Del.

Jacques, William W., Ph.D., Electrician, American Bell Telephone Company, 95, Milk-st, Boston, Mass.

Jaeger, H. J., Incandescent Lamp Manufacturer, 173, Pearl-st, Brooklyn, N.Y.

James, John N., Electrician, Naval Observatory, Washington, D.C.

Jannus, Frankland, Solicitor of Patents, Atlantic-bldg, 928-930, F-st, Washington, D.C.

Jeffrey Manufacturing Company, Manufacturers of Electric Mining Machines, 162, East First-avenue, Columbus, Ohio

*Jehl, Francis, Electrical Engineer and Representative of F. Hardtmuth & Co (Electric Carbon Manufacturers, Vienna) in the United States.

Jenks, W. J., Patent Expert, Legal Department, General Electric Company, 44, Broad-st, New York. (*3644 Cortlandt*)

Jenney Electric Motor Company, Manufacturers of Electric Motors and Machinery, 224, South Illinois-st, Indianapolis, Ind.; and 932, Monadnock-bldg, Chicago, Ill.

Jenny Star Electric Company, Manufacturers of Dynamos and Motors, 176, Summer-st, Boston, Mass.

Johns Hopkins University, Baltimore, Md. (Louis Duncan, Ph.D., Prof. of Electricity)

Johns (H. W.) Manufacturing Company—*see* H. W. Johns Manufacturing Company

Johnson Electric Service Company, Manufacturers of Electrical Machinery, Milwaukee, Wis.

Johnson, E. H., Electrical Engineer and Electrician, President Interior Conduit and Insulation Company, 42 and 44, Broad-st, New York

Johnson Railroad Signal Company, Manufacturers of Electric Signals, 47, Broadway, New York; and Rahway, N.J.

Johnson Standardising Company, Electrical Experts, 42 and 44, Broad-st, New York

Johnson Storage Battery Company, Storage Battery Manufacturers, 10, Mount Washington-st, Boston, Mass.

Johnston, A. Langstaff, C.E., Consulting Engineer, Heslonille, Mantua and Fairmount Passenger R. R. Company, 4300, Lancaster-ave, Philadelphia, Pa.

JOHNSTON (W. J.) COMPANY, Limited, Proprietors of the New York *Electrical World*, and Booksellers and Publishers of Electrical Works, 167-177, Times-bldg, New York. (*Electrical New York*)

Agents in Great Britain for the W. J. Johnston Company's Publications, "THE ELECTRICIAN" PRINTING AND PUBLISHING COMPANY, *Ltd., 1, 2 and 3, Salisbury-ct, Fleet-st, London, E.C.*

Jones (Bros) Electric Company, Manufacturers of Electrical Supplies, 30, Court-st, Cincinnati, Ohio

Jones (F. P.) & Co, Dealers in Electrical Apparatus, 255, Pearl-st, Buffalo, N.Y.

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Jones, Prof. Forrest R., Electrical and Mechanical Engineer, (Professor of Machine Design, University of Wisconsin, Madison, Wis.)

Jones, F. W., Chief Electrician, Postal Telegraph Cable Company, 5, Dey-st, New York

Jones (J.) & Son, Electrical Apparatus Makers, 32, Vesey-st, New York.

Jones, Sebastian C., Electrical Engineer, Aurora, N.Y.

Jordan, A., Superintendent Western and Brazilian Telegraph Company, Para, Brazil

Jordan (L. J.) & Co, Electrical Apparatus Makers, 133, Oliver-st, Boston, Mass.

Jost, Edmund, Manufacturer of Electrical Apparatus, 350 and 352, Plane-st, Newark, N.J.

Judson, Wm. Pierson, M.I.C.E., Electrician, U.S. Civil Engineer, Oswego, N.Y. (*Oswego New York, 85*)

— K —

Kansas City Electrical Works, Manufacturers of Electrical Apparatus, Kansas City, Mo.

K.A.P. Electrical Novelty Company, Manufacturers of Electrical Novelties, South Second-st, La Crosse, Wis.; and 440, Monadnock-bldg, Chicago, Ill.

Keiper, Frank, Electrical Engineer, 133, Grant-st, La Fayette, Ind.

Keith, Dr. N. S., Electrical Engineer, Electrical Engineering Company, 711, Jones-st, San Francisco, Cal.

Keller & Degenhardt, Consulting Electrical Engineers, 542, The Rookery, Chicago, Ill.

Kellogg, Henry F., Electrical Engineer, 146, Franklin-st, Boston, Mass.

Kellogg, James W., Assistant to General Manager, Lighting Department, General Electric Company, 140, East Twenty-Seventh-st., New York

Kellogg, Milo G., Electrician, 135, Forty-seventh-st, Chicago, Ill.

Kelly, I. W., Manufacturer of Electric Light Fittings, 1236, Filbert-st, Philadephia, Pa.

Kendall (M. K.) & Co, Electrical Engineers and Dealers in Electrical Supplies, 8, Oliver-st, Boston, Mass. (*3496*)

Kennedy, Patrick, Electrical Engineer, 105, Johnson-st, Brooklyn, N.Y.

Kennedy, John R., Manufacturer of Electrical Apparatus, P.O. Box 593, San Bernadino, Col.

*Kennelly, A. E., Consulting Electrician and Electrical Engineer, Edison Laboratory, Orange, N.J.

Kerr, F. W. (British vice-Consul at Santiago), General Manager and Representative on the West Coast of the Chili Telephone Company, 13, Galeria San Carlos, Santiago, Chili. (*Chiliadal Santiago.*)

Kester Electric Company, Manufacturers of the Kester Dynamos and Motors, &c., 173, South Canal-st, Chicago, Ill.; and Terre Haute, Ind.

Keystone Electric Company, Makers of Dynamos and Electric Motors, cor. Fourteenth and State-sts, Erie, Pa.

Khotinsky, Capt. Achilles de, Electrical Engineer and Inventor, Marlboro, Mass.

Kidder (Jerome) Manufacturing Company, Electrical Apparatus and Instrument Makers, 820, Broadway, New York

Kimball, Arthur L., Ph.D., Professor of Physics, Amherst College, Amherst, Mass.

Kimball, A. S., Professor of Physics, Worcester Polytechnic Institute, Worcester, Mass.

King (H.) & Son, Manufacturers of Electrical Apparatus, Corry, Pa.

Kingsbury & Mustard, Electrical Engineers and Contractors, Baltimore, Md.

Kingsford, H., Electrical Engineer, and Engineer to the Mexican and Central and South American Telegraphs, Lima, Peru. (Local Hon. Secretary of the Institution of Electrical Engineers.)

Kinney, Edward P., Electrical Engineer, 634, Warren-avenue W., Detroit, Mich.

Kinsman, F. E., Electrical Engineer, 96, Broadway, New York; and Plainfield, N.J.

Klees, W. H., Electrician and Inventor of the Klees Arc Lamp (Electric Light, Heat and Power Company), Susquehanna, Pa.

Klein (Mathias) & Son, Makers of Electrical Tools, Apparatus, &c., 87 and 89, West Van Buren-st, Chicago, Ill. (*4084*)

Klein's (John M.) Electrical Works, Manufacturers of Electrical Apparatus, 1007-1009, Alabama-st, San Francisco, Cal.

Knapp Electric and Novelty Company, Manufacturers of Battery Motors and Electrical Specialities, 34, Warren-st, New York

Knapp Electrical Works, Makers of Insulated Wires and Cables and the "Thomas" Electric Motor, 271-273, Franklin-st., Chicago, Ill.

Knauff (Theo. C.) & Co, Manufacturing Electrical Engineers, Newark, Del.

Knight Bros, Electrical and Patent Experts, Fulton-bldg, Fulton and Nassau-sts, New York. (*Cantata New York*)

*Knight, W. H., Chief Engineer, Railway Department, General Electric Company, Boston, Mass

Knowles, E. R., Electrical and Civil Engineer, Chief Electrician, Schuyler Electric Company, Middletown, Conn.

Knox Electric Company, Electrical Engineers and Contractors, Haverhill, Mass.

Knudson Cuttriss Wire Company, Limited, Manufacturers of Insulated Wire, 37-38, Drexel-bldg, Philadelphia, Pa.

Kreidler, W. A., Editor and Publisher of the *Western Electrician*, 6, Lakeside-bldg, Chicago, Ill.

Krogh Manufacturing Company, Manufacturers of Electrical Apparatus, San Francisco, Cal.

— L —

La Boiteaux Electric Motor and Fan Company, Makers of the Cyclone Motor, 376, Walnut-st, Cincinnati, O.

Laclede Carbon and Electric Light Company, Manufacturers of Insulating Materials, Cut Outs, &c., Kokomo, Ind. (P. C. Burns, Manager)

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La Due (J. D.) & Co, Electrical Engineers and Contractors, Marquette, Mich.

Laidlaw - Dunn - Gordon Company, Manufacturers of Steam Pumps, Turbines, &c., Cincinnati, Ohio

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Land, Frank, Electrical Expert, General Electric Company, Park-st, Lynn, Mass.

Lane Manufacturing Company, Manufacturers of Electrical Apparatus, Kenosha, Wis.

Lamp Socket Manufacturing Company, Makers of Incandescent Lamp Sockets, Taylor-bldg, 39 and 41, Cortlandt-st, New York

Lang (J.) & Co, Switch Makers, 44, Michigan-st, Chicago, Ill.

Lange, Philip A., Electrician, Assistant Superintendent, Westinghouse Electric and Manufacturing Company, Newark, N.J.

Langstad, Peterson & Croswell, Electrical Engineers, Appleton, Wis.

Lanza, F. A., Inspector-General of Telegraphs, London Platino Brazilian Telegraph Company, Montevideo

La Roche Electric Works, Manufacturers of Electrical Machinery and Apparatus, American and Diamond-sts, Philadelphia; and Pittsburgh, Pa.

Lattig, J. W., Electrical Engineer and Superintendent of Telegraph Lines, Lehigh Valley R. R. Co, South Bethlehem, Pa.

Law Battery Company, Manufacturers of the Law Battery for Telephones, Bells, and Battery Supplies, 85, John-st, New York

Law, Myron D., Electrician, Manager Arc Light Department, General Electric Company's Machine Works, Schenectady, N.Y.

Lawrence Manufacturing Company, Manufacturers of Electrical Supplies, Columbus, O.

Leavitt Motor Company, Makers of the Leavitt Fan-Motor, 121, Michell-st, Providence, R.I.

LECLANCHE BATTERY COMPANY, 111-117, East 131-st, New York. (Horatio J. Brewer, Treasurer and General Manager.) **See Advt., p. 448**

Lee, H. K., Mechanical and Electrical Engineer, 223, State-st, Hartford, Conn.

Leete, W. C., Electrical Engineer and Manager, Syracuse Electrical Manufacturing Company, Syracuse, N.Y. (*293*)

Leffel (James) & Co, Manufacturers of Turbines, Springfield, Ohio; and 110, Liberty-st, New York (*Leffel New York*)

Lennon, J. M., Consulting Electrical and Mechanical Expert, 22, Loan-and-Trust-Company-bldg, Minneapolis, Minn.

Leonard (H. Ward) & Co, Consulting and Contracting Electrical Engineers, Electrical Exchange-bldg, New York. (*83A Cortlandt*)

Leonard, M. B., Electrical Engineer and Superintendent of Telegraphs, Chesapeake and Ohio Railway Company, Richmond, Va.

Lewis, Minford, Electrical Engineer, 50-54, N. 4th-st, Philadelphia, Pa.

*Lieb, John W., jun., Electrical Engineer, Edison Electric Illuminating Company, Pearl (Cor. Elm)-st, New York; and 22, Chestnut-st, Newark, N.J.

Lieb Machine Works, Manufacturers of all kinds of Electrical Machinery and Supplies, 23, Vandewater-st, New York

Liebig, Gustav A., jun., Electrical Testing Department, Johns Hopkins University, Baltimore, Md.

Liggett, J. C., Electrician and Electrical Expert, Michigan Insurance and Inspection Bureau, Detroit, Mich.

Lima Electric Company, Electrical Engineers and Contractors, Lima, Peru

Lincoln Electric Company, Electrical Engineers Cleveland, O.

Lincoln Electrical Manufacturing Company, Manufacturers of the "Diamond" Incandescent Lamp, Lincoln, Neb.

Lindsay & Wilgus, Electric Traction Engineers and Contractors, 59, William-st, New York

Lineff, A. L., Electrician, 52, Tribune-bldg, New York

Little, E. W., General Manager, Interior Conduit and Insulation Company, 44, Broad-st, New York

Little (F. P.), Electric Construction and Supply Engineers and Manufacturers of Electrical Supplies, 135, E. Seneca-st, Buffalo, N.Y. (*96*)

Livingston, C. L., Electrical Engineer and Contractor, Fidelity-bldg, Fourth-avenue, Pittsburg, Pa.

Lloyd & Paxton, Limited, Manufacturers of Storage Batteries, 2, Wall-st, New York

Lloyd, Robert McA., Electrician of the Marion (N.J.) Factory, United Electric Traction Company, 2, West Thirty-sixth-st, New York

*Lockwood, Thomas D., Advisory Electrician and Patent Expert, P.O. Drawer 2, Boston, Mass.

Long Island Electric Construction and Equipment Company, Electrical Engineers, Brooklyn, N.Y.

Long, J. H., Manufacturer of Electrical Apparatus, 164, High-st, Boston, Mass.

Loomis, Osborn P., Electrical Engineer, Bound Brook, N.J.

Love Electric Traction Company, Owners of the "Love" Underground Traction System, 817, The Rookery, Chicago, Ill.

Lovejoy, J. R., Electrical Engineer (Marine Department), General Electric Company, 620, Atlantic-avenue, Boston, Mass.

Lovell Manufacturing Company, Limited, Makers of the "Niagara" Dynamos and Motors, Erie, Pa.

Loveridge (H. B.) & Bros, Electrical Engineers, 106, Alder-st, Portland, Ore.

Low, Geo. P., Electrical Expert and Inspector, Pacific Insurance Union, P.O. Box 2115, and 303, California-st, San Francisco, Cal.

Lozier, Robert T. E., Electrical Expert, General Electric Company, Edison-building, New York. (*Xydsun New York*)

Lucock, J. S., Electrician, Western Union Telegraph Company, Pittsburgh, Pa.

Lumley, F., General Superintendent Chili Telephone Company, 18D, Castilla, Santiago, Chili. (*Electrode Santiago*)

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Lundell, Robert, Electrical Engineer, Interior Conduit and Insulation Company, 44, Broad-st, New York

Lunkenheimer Company, Makers of Lubricator Valves and Grease Cups, 11-17, East Eighth-st, Cincinnati, Ohio

Luquer, Thatcher T. P., Electrical Engineer, Union Electric Company, 45, Broadway, New York

Lynch, Eugene T., Junior, Consulting Electrical Engineer, 120, Broadway, New York

Lynchburg Electric Company, Electrical Engineers and Contractors, Lynchburg, Va.

Lynden Electric Motor and Railway Company, Manufacturers of Electrical Motors, &c., Lynden, Wash.

Lyne, Lewis F., Electrical and Mechanical Engineer, 307, Grove-street, Jersey City, N.J.

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McCarthy, Lawrence, A., Electrician and Superintendent, Western Union Telegraph Company, 1053, Bedford-avenue, Brooklyn, N.Y.

McCreary Electrical Specialty Company, Dealers in Electrical Supplies, Electrical Exchange-bldg, New York

McDougall & Cummings, Manufacturers of Electrical Apparatus, Unity-bldg, Chicago, Ill.

McEvoy, E. J., Electrical Engineer and Superintendent of Electricity, William Cramp & Sons, Philadelphia, Pa.

Macfarlane, Alexander, Consulting Electrical Engineer and Electrician and Professor of Physics, University of Texas, Austin, Texas

McGhie, John, Electrician, General Electric Company, 44, Broad-st, New York

McIntire Manufacturing Company, Makers of Electric Wire Connections and Terminals, 13 and 15, Franklin-st, Newark, N.J.

McIntosh Battery and Optical Company, Manufacturers of Galvanic Batteries, 141, Wabash-ave, Chicago, Ill.

McKay, C. R., Consulting Electrical Engineer, 140, S. Main-st, Salt Lake City, Utah

McKay (W. H.) & Co, Electrical Engineers and Contractors, Roanoke, Va.

McKenna, Ryan & Sons, Electrical Engineers, Pittsburgh, Pa.

Mackie, Robb, Electrical Engineer, C. and C. Electric Company (Incorporated), 143, Liberty-st, New York

McKinstry, J. P., Electrical Engineer, 316, Seneca-st, Cleveland, O.

McLain (J. H.) Machine Company, Manufacturers of Dynamos and Motors, Canton, O.

McLaughlin, James, Arc Lamp Maker, 48—52, N. Clinton-st, Chicago, Ill.

McLean Engineering Company, Consulting and Contracting Engineers for Steam and Electric Plants, &c., 136, Liberty-st, New York

McLeod, John, Consulting Electrical Engineer, Louisville, Ky.

McLeod, Ward & Co, Electrical and Mechanical Engineers, 91, Liberty-st, New York

Macloskie, Chas. A., Electrical Engineer, c/o Prof. G. Macloskie, Princetown University, Princetown, N.J.

McNeill, David, Electrician, Secretary to Representative Western and Brazilian Telegraph Company, 2, Rua do General Camara, and P.O. Box 453, Rio de Janeiro, Brazil (*210*)

MacQuesten, William D., Electrical Engineer and Contractor, 15, Cortlandt-st, New York

McRae, V. H., Maker of the Elastic Accumulator, 87, Pulitzer-bldg, New York

Macraeon Storage Battery Company, Makers of the Macraeon Storage Battery for Electric Lighting, &c., 7, Wall-st, New York

Madden, Oscar E., Electrical Engineer, Electrical Exchange-bldg, 136, Liberty-st, New York

Magee, F. A., M.E., Consulting Engineer, E. S. Greeley Company, 5 and 7, Dey-st, New York

Magneto-Electric Manufacturing Company, Manufacturers of Electrical Apparatus, 518, 520 and 522, West 35th-st, New York

Mailloux, C. O., Consulting and Constructing Electrical Engineer, 45, William-st, New York (*Maillour New York*)

Main, Prof. W., Electrician, Union Electric Company, 45, Broadway, New York

Maine Electric Improvement Company, Electrical Engineers and Contractors, Brunswick, Me., and Electrical Exchange-bldg, New York

Maine Electrical Construction Company, Manufacturers of Electrical Apparatus, Fairfield, Me.

Manning, Maxwell & Moore, Dealers in Electrical Supplies, 111 and 113, Liberty-st, New York

Mandelick, W. E., Electrical Engineer, with Interior Conduit and Insulation Company, 44, Broad-st, New York (*Conduit New York*)

Manhattan Electrical Supply Company, Manufacturers of the Mesco Dry Battery, &c., 36, Cortlandt-st, New York; and 14-20, Morris-st, Jersey City, N.J. (*Mesco New York, 2815 Cortlandt*)

Manion & Co, Manufacturers of Electrical Apparatus, New Orleans, La.

Mansfield Electrical Manufacturing Company, Manufacturers of Electrical Apparatus, Mansfield, O.

Mansfield, George W., Electrical Engineer, General Electric Company, 620, Atlantic-avenue, Boston, Mass.

Manufacturer and Builder (monthly), 83, Nassau-st, New York. (Henri Gerard, Publisher.) (Ann. sub., $1.50; P.U., $1.98)

Mardock, W. H., Superintendent, Western and Brazilian Telegraph Company, Ceara, Brazil

*Marks, Louis Benedict, Chief Electrician, Royal Arc Electric Company, 51, E. 67th-st, New York

Marks, Prof. W. D., Ph.B., C.E., President Edison Electric Light Company, 909, Walnut-st, Philadelphia, Pa. (*820*)

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Maris & Beekley, Manufacturers of Electric Cranes & Lifts, 2343-2345, Callowhill-st, Philadelphia, Pa.

Marsh, C. D., Sole Selling Agent of the "Kolon" Primary Battery, 136, Liberty-st, New York

Marshall, J. T., Electrical Engineer, Metuchen, N.J.

Marshall, William, Manufacturer of Electrical Condensers, 2 and 4, University-bldg, cor. Waverley and University-places, New York

Martin, C. B., Electrical and Mechanical Engineer, Special Production Department, General Electric Company, Lynn, Mass.

Martin, J., Electrical Engineer, 16, Oak-st, Newark, N.J.

Martin, T. Commerford, Editor *Electrical Engineer*, and Past President of the American Institute of Electrical Engineers, 203, Broadway, New York (*Lengineer New York, 3860 Cortlandt*)

Martins da Silva, Jose, Manufacturer of Electrical Apparatus, 1, Travessa da Se, and 109, rue do Brazil, Sao Paulo, Brazil

Martland, Robert W., Electrical Engineer and Manager, Pacific Electric Contracting Company, 426, Haight-st, San Francisco, Cal.

Marvin Electric Drill Company, Makers of Electric Drills, Schenectady, N.Y. (Harry N. Marvin, Electrician)

Mason, Alfred Bishop, Electrical Engineer and Manager, Sprague, Duncan & Hutchinson, Limited, 15, Wall-st, New York

Mason, Augusté F., Electrical Engineer and General Manager, Simplex Electric Company, 620, Atlantic-avenue, Boston, Mass.

Mason, James H., Electrician and Superintendent, Mason Battery and Electrical Company, 10-12, Vandewater-st, New York

Mason, J. W., Manufacturer of Electrical Supplies, 527, Delaware-st, Kansas, Mo.

Mason Electric Company, Manufacturers of the "Mason" Storage Battery, 10 and 12, Vandewater-st, New York

Massachusetts Electrical Engineering Company, Electrical Engineers, 4, Post Office-sq, Boston, Mass. (Stone & Webster, Managers.) (*Electreng Boston, 873*)

Massachusetts Institute of Technology, Boston, Mass. (Professor Charles R. Cross, in charge of Department of Electrical Engineering)

Massachusetts Manufacturing and Electrical Supply Company, Manufacturers of Electrical Machinery and Supplies, Chelsea, Mass.

Massachusetts Chemical Company, Manufacturers of Acids and Insulating Materials, 8, Oliver-st, Boston, Mass.; and 823, Monadnock-bldg, Chicago, Ill.

Masters Electrical Company, Electrical Engineers & Contractors, 316, Main Arcade, Evansville, Ind.

Mather Electric Company, Manufacturers of the Mather Electric Lighting System, Manchester, Conn; and at 116, Bedford-st, Boston, Mass.

Matthews & Willard Manufacturing Company, Manufacturers of Electrical Supplies, 40, Murry-st, New York.

Maver, Wm., jun, Electrical Expert and Patent Solicitor, 32, Nassau-st, New York

Maynard, Geo. C., Electrical Engineer, 1,409, New York-avenue, Washington, D.C.

Mechanics' General Manufacturing Company, Electrical and Mechanical Engineers, St. Paul, Minn

Mechanical and Electrical Progress (monthly), 925, Chestnut-st, Philadelphia, Pa. (Ann. sub., P.U., $2=8s. 4d.)

*Mendenhall, T. C., M. D., Electrician, Superintendent U.S. Coast and Geodetic Survey, Washington, D.C.

Menominee Electric and Mechanical Company, Manufacturers of Electrical Apparatus, Menominee, Mich.

Mercer, Andrew G., Electrician and Treasurer, Waterloo Electric Company, Waterloo, N.Y.

Mercer Electric Machine Company, Manufacturers of Dynamos and Motors, Cincinnati, O.

Meserole & Co, Electricians, 26, Church-st, New York

Metcalfe, George R., Electrical Engineer, Editor of *Electricity*, 6, Park-pl, and 404, West 22nd-st, New York

Metropolitan Electric Company, Manufacturers of Electrial Apparatus, 522 and 523, Monadnock-bldg, Chicago, Ill. (Wm. H. McKinlock, President.) (*Insulation Chicago*)

Metropolitan Electric Service Company, Electrical Engineers, 575, Madison-avenue, and 120, Broadway, New York

Metropolitan Electrical Corporation, Electrical Engineers and Contractors, 415, 416 and 417, Whitney-bldg, Kansas City, Mo.

Metropolitan Telephone and Telegraph Company, 18, Cortlandt-st, New York

Meyer, Julius, Consulting Engineer, 7, Beekman-st, New York

Meyrowitz Bros, Manufacturers of Batteries and Electrical Apparatus, 295 and 297, Fourth-avenue, New York

Mexican Telegraph Company, 37 and 39, Wall st, New York, (James A. Scrymser, President; Jas. R. Beard, Secretary)

Miamisburg Electric Company, Manufacturers of Electrical Apparatus, Miamisburg, O.

Mica Asbetite Insulating Company, Manufacturers of Insulating Materials, 444, Pearl-st, New York

Midland Electric Company, Makers of Electrical Supplies and Machinery, 1616 and 1618, Seventeenth-st, Denver, Colo.

Midland Electric Works, Manufacturers of Electrical Specialities, 108, Fifth-Avenue, Chicago, Ill.

Miller Electric Company, Manufacturers of Electrical Appliances, 13, Astor Place, New York

Miller (Joseph A.) & Co, Consulting Electrical Engineers and Experts, 25, Butler Exchange, Providence, R.I.

Miller, W. C., Electrical Engineer, 3, South Hawk-st, Albany, N.Y.

Mills, Frank P., Electrical Engineer, Superintendent Cleveland Iron Mining Company, Ishpeming, Mich.

Milwaukee General Construction Company, Manufacturers of Arc and Incandescent Lamps, Monadnock-bldgs, Chicago, Ill. (F. H. Prentiss, President)

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Miner, W. M., Electrician and Inventor, General Manager American Manufacturing and Engineering Company, 96, Broadway, New York

Minneapolis Electric & Construction Company, Electrical Engineers and Contractors, 27, South Fourth-st, Minneapolis, Minn.

Mitchell, J. Murray, Electrical Expert, P.O. Box, 3,712, 45, Wall-st, New York

Mitchell Electric Company, Dealers in Electrical Apparatus, St. Paul, Minn.

Mitchell, Vance & Co, Electrical Engineers, 836, Broadway, New York

Molecular Storage Battery Co, Manufacturers of Storage Batteries, 95, Milk-st, Boston, Mass.

Moling, W. E., Electrical Engineer, 43½, North High-st, Columbus, O.

Monrath, Gustave, Electrical Engineer, 1302, Auditorium Tower, Chicago, Ill.

Montana Electric Company, Electrical Engineers and Contractors, Butte, Montana

Monte Video Telephone Company, Limited, Calle Rincon, Monte Video, South America. (*See also* BRITISH DIVISION)

Moore Electrical Manufacturing Company, Makers of Electrical Supplies, West Thirteenth-st, (cor. Hudson-st), New York

Moore, A. F., Insulated Wire Maker, 200 and 202, North Third-st, and 301-305, Race-st, Philadelphia, Pa.

Moore & Wyman, Makers of Electric Lifts, Cranes, &c., cor. Granite and Richards-sts, South Boston, Mass.

Morris, H. G., Storage Battery Manufacturer, Drexel-bldg, Philadelphia, Pa.

Morrison, Geo. H., Consulting Electrical Engineer, Federal-st, Boston, Mass

Morse, Williams & Co, Makers of Electric Cranes and Elevators, 105, Frankford-avenue, Philadelphia, Pa.

Morss, Everett, Electrician, Simplex Electric Company, 297, Beacon-st, Boston, Mass.

Mortimer Norden Electrical Company, Electrical Engineers and Contractors, 4, East Sixtieth-st, New York

Moses, Dr. Otto A., Consulting Electrician and Inventor, 1037, Fifth-avenue, New York

Mosher Electric Company, Makers of the Mosher arc Lamp, 125-127, Ontario-st, Chicago, Ill.

Mosher, John A., Electrical Engineer, Abilene, Kansas

Mosquero, J., Importer of Electric Stores, 65, Olispo-st, Havana

Moss, Geo. W., Manager, Mexican Telegraph Company, Vera Cruz, Mexico

Mosscrop, Wm. A., M.E., Electrical Engineer, 128, Oliver-st, Boston, Mass. (*3271*)

Mott, S. D., Electrical Engineer, Passaic, N.J.

Mountain Electrical Manufacturing and Construction Company, Manufacturers of Electrical Supplies, Meyersdale, Pa.

Mountford, W. H., Superintendent, Anglo-American Telegraph Company, 8, Broad-st, New York

Muckle (M. R., jr.) & Co, Mechanical and Electric Light Engineers, 210, Drexel-bldg, Philadelphia, Pa. (*Muckle Philadelphia*)

Mudge, N., Electrical Engineer, 14, Herald-bldg, Omaha, Neb.

Muldaur, Geo. B., M.E., Assoc. Editor, *The Electrical Engineer*, 203, Broadway, New York (*Lenaineer New York ; 3860 Cortlandt*)

Muncie Electrical Works, Makers of the Muncie Dynamo & Motor, Mancie, Ind.

Munn & Co, Publishers of the *Scientific American* and Patent Solicitors, 361, Broadway, New York

Munsell (Eugene) & Co, Mica Dealers, **218, Water-st, New York**

Murray (Thomas) Company, Electrical Engineers and Contractors, 136, Liberty-st, New York

Mutual Union Telegraph Company (Rapid Cable Telegraphing), 96, La Salle-st, Chicago, Ill.

Myers, Geo. Francis, Electrical Engineer, Penn-bldg, Pittsburgh, Pa.

Mystic Electric Motor Co, Battery & Motor Manufacturers, 120, Tremont-st, Boston, Mass.

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Nardi, Stang & Co, Dealers in Electrical Supplies, Philadelphia, Pa.

Nassau Electrical Company, Manufacturers of the Sealed Capsule Chloride of Silver Battery, &c., 112, White-st, New York

National Carbon Company, Manufacturers of Electric Light Carbons, 40, Willson-avenue, Cleveland, Ohio

National Electrical Manufacturing Company, Manufacturers of Electrical Apparatus, Milford, Conn.

National Electric Brake Company, Manufacturers of Electric Brakes, St. Louis, Mo.

National Electric Company, Electrical Engineers, 1231, Filbert-st, Philadelphia, Pa.

National Electric Company, Manufacturers of Electrical Machinery, Eau Claire, Wis.

NATIONAL ELECTRIC LIGHT ASSOCIATION, 136, Liberty-st, New York. (Geo. F. Porter, Secretary)

National Electric Light and Power Company, Makers of the "Cohen" Dynamo and Arc Lamps, &c., Bullitt-bldg, Philadelphia, Pa.

National Electric Manufacturing and Construction Company, Dealers in Electrical Supplies, Electrical Exchange-bldg, New York

National Galvanic Battery Company, Manufacturers of Galvanic Batteries, 18, Cortlandt-st, New York

National India Rubber Company, India Rubber Manufacturers, Bristol, R.I.; and at Boston, Mass.

National Storage Battery Company, Ltd., Manufacturers of Storage Batteries, 626, Hammond-bldg, and cor. Fifth and Congress-streets, Detroit, Mich

National Telephone Exchange Association, 20, Cortlandt-st. New York.

National Telephone Manufacturing Company, Makers of the Bennett Telephone, 620B, Atlantic-avenue, Boston, Mass.

Nebraska Electrical Manufacturing Company, Electrical Engineers, 1519, Harnay-st, Omaha, Neb.

Needham, R. J., Superintendent, Anglo-American Telegraph Co, Duxbury, Mass.

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Neftel, O'Connor and Company (Incorporated), Electrical Engineers and Contractors, 126, Liberty-st, New York. (J. Stanford Brown, Secretary.) (*1841 Cortlandt*)

Nery da Fonseca, I., Commission Agent and Importer of Electrical Supplies, P.O. Box 202, and 60, Rua Marquez de Olinda, Pernambuco, Brazil. (*Nery Pernambuco*)

Neutral Storage Battery Company, Manufacturers of Storage Batteries, Newark, N.J.

New American Electrical Arc Light Company Manufacturers of the "American" System of Electric Arc Lighting (Woods Patent), 2, Cortlandt-st, and 163 to 165, West 18th-st, New York

New Central Electric Company, Electrical Engineers and Contractors, Minneapolis, Minn.

New Century Electric Company, Electrical Engineers and Makers of the "New Century" Dynamo, 21 to 25, Bethune-st, New York

New England Electric Exchange, 44, Broad-st, New York. (Timothy W. Sprague, Secretary and Treasurer.) (*3644 Cortlandt*)

New England Insurance Exchange, 55, Kilby-st, Boston, Mass. (C. M. Goddard, Secretary and Electrician)

New Gaynor Electric Company, Manufacturers of Electrical Appliances, Louisville, Ky.

New Haven Insulated Wire Company, Manufacturers of Electric Wires and Cables, Haven and Market-sts, New Haven, Conn.

New Jersey Electrical Company, Manufacturers of Electrical Supplies, 921, Broad-st, and 10, West-st, Newark, N.J. (*575*)

New York Belting and Packing Company, Makers of Vulcanized Rubber Driving Bands, &c., 15, Park-row, New York. Works: Newtown, Conn., and Passaic, N.J. (*See also* BRITISH DIVISION)

New York Carbon Works, Makers of Carbon Plates for Electrical Purposes, 18, Cortlandt-st, New York

New York Electric Equipment Company, Manufacturers of and Dealers in Electrical Apparatus, Duane-st, New York

New York Electrical and Development Company, Manufacturers of Electrical Apparatus, 251-253, William-st, New York

New York Electrical Engineering Company, Contractors for Electric Railways and Electric Light and Steam Plants, 45, Broadway, New York

New York Electrical Manufacturing Company, Manufacturers of the Barriett Motor and Dynamo, 110, West 23rd-st, New York

New York Electrical Society, 534, Temple-court, New York. (Geo. H. Guy, Secretary)

New York Electrical Works, Manufacturers of and Dealers in Electrical Supplies, 161, Washington-st, New York

New York Insulated Wire Company, Makers of New "Grimshaw" White Core Wires and Cables, 13-17, Cortlandt-st, New York; and at Chicago, Ill.; San Francisco, Cal., and Boston, Mass.

Ney, R. W., Dynamo and Motor Maker, Mechanic-st, Hartford, Conn.

New York and Ohio Company, Manufacturers of the "Packard" Incandescent Lamp, Warren, O.

Newell, Arthur J., Electrical Engineer, Messrs. Roland T. Oakes & Co., 366, High-st, Holyoke, Mass.

Newton Electric Company, Manufacturers of Electrical Apparatus, 39, Cortlandt-st, New York

*Nichols, Edward L., Ph.D., Professor of Physics, Cornell University, Ithaca, N.Y.

Nicholson Electric Hoist Company, 84, Champlain-st, Cleveland, O.

Nickerson, William E., Electrical Expert, Cambridge, Mass.

Nordlund Arc Lamp Company, Makers of the Nordlund Arc Lamp, Seattle, Wash.

North Manufacturing Company, Manufacturers of Electrical Machinery, Denver, Colo.

Northern Electrial Supply Company, Manufacturers of Electrical Supplies, Depot-st, Martin, and Luscombe-block, Concord, N.H.

North-West Electric Manufacturing Company, Electrical Engineers and Contractors, Portland, Ore.

Norton, Elbert Fafette, City Electric Light Inspector, 15, City Hall, Chicago, Ill.

Norwich Insulated Wire Company, Makers of Paper-Insulated Wires and Cables, 44, Broad-st, New York; and Harrison, N.J. (*Insulwire New York, 4787 Cortlandt*)

Nosworthy, W. F., Electrician, Western and Brazilian Telegraph Company's s.s. "Norseman," Pernambuco, Brazil

Novelty Electric Company, Manufacturers of High Grade Electrical Supplies, 50-54, North Fourth-st, Philadelphia, Pa.

Nowotny Electric Company, Manufacturers of the Diaphragm Dry Battery, 30, East Fifth-st, Cincinnati, Ohio

Nunn, R. J., M.D., Consulting Electrician, 119½, York-st, Savannah, Ga.

Nuttall (R. D.) Company, Makers of Electric Railway Supplies, 179, Grant-avenue, Allegheny, Pa.

Nutting Electric Manufacturing Company, Makers of the Nutting Arc Lamp, 128 and 130, South Clinton-st, Chicago, Ill.

— O —

Oakes (Roland T.) Co (Incorporated), Electrical Engineers and Contractors, 366, High-st, Holyoke, Mass.

O'Bryen, A. C., Electrician, West India and Panama Telegraph Company's s.s. "Grappler," West Indies

Ockershausen, H. A., Electrical Engineer, 65, Madison-avenue, Jersey City, N.J.

O'Dea, M., Teacher of Electricity, University of Notre Dame, Notre Dame, Ind.

Oelschlaeger Bros, Manufacturers of Electrical Apparatus, 42, East 23rd-st, New York

Okonite Company, Ltd, Makers of Insulated Wires and Cables, 13, Park-row, New York. Works: Passaic, N.J. (*See also* BRITISH DIVISION)

Ohio Construction Company, Electrical Engineers, 54, Franklin-st, Cleveland, O.

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Ohio State University, Columbus, Ohio. (Benj. F. Thomas, M.Sc., Ph.D., Professor of Physical and Electrical Technology)

O'Keenan Electric Manufacturing Company, Electrical Apparatus Makers, Aldrich-ct, 45, Broadway, New York.

Olan, Theodore J. W., Civil and Electrical Engineer, 61, W. Thirty-seventh-st, New York

Oldham, James, Engineer, Compañia Telegrafica del Rio de la Plata, Monte Video

Oldham, John, Administrador Compañia Telegrafica del Rio de la Plata, and Manager of the Western and Brazilian Telegraph Company, Monte Video. (Local Hon. Secretary of the Institution of Electrical Engineers at Monte Video). (*Oldham Montevideo*)

Onandaga Dynamo Company, Makers of the Averill Dynamo, 225-229, Walton-st, Syracuse, N.Y.

Ongley Electric Company, Manufacturers of Electrical Apparatus, 1, Broadway, New York

O'Reilly, Andrew J., Supervisor of City Lighting and Inspector of Wires, Room 33, City Hall; and 1507 Papin-st, St. Louis, Mo.

Orient Electric Company, Manufacturers of Electrical Machinery, Youngstown, O.

Orne Electric Construction Company, Practical Electricians and Contractors, 112, Randolph-st, Chicago, Ill.

Orr and Howe Electric Company, Electrical Engineers, 423, Smithfield-st, Pittsburgh, Pa.

Osborne, Loyall A., Electrical Engineer, Westinghouse Electric and Manufacturing Company, 29, Plant-st, Newark, N.J.

Osburn, Harry G., Consulting Electrical Engineer, 348, Dearborn-st, Chicago, Ill. (*306*)

Osmond, I. Thornton, M.S., M.A., Professor of Physics, Pennsylvania State College, State College, Pa.

Ostrander (W. R.) & Co, Manufacturers of Electrical and Mechanical Apparatus, 204, Fulton-st, New York

Otis Brothers & Co., Manufacturers of the "Otis" Electric Elevator, 38, Park-row, New York

Otis Electric Company, Manufacturers of Electric Motors, Yonkers, N.Y.

Otto, (F. G.) & Sons, Manufacturers of Medical Batteries, 44-50, Sherman-avenue, Jersey City, N.J.

Otto Gas Engine Works, Makers of the "Otto" Gas Engine, 33rd and Walnut-sts, Philadelphia, Pa.

Overton (E. L.) & Co, Manufacturing Electrical Engineers, 830, Kansas-avenue, Topeka, Kansas

Owens, R. B., Professor of Electrical Engineering, University of Nebraska, Lincoln, Neb.

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Pacific Electric Contracting Company, Electrical Engineers and Contractors, San Francisco, Cal. (*4024*)

Pacific Electrical Storage Company, 118 & 120, Pine-st, San Francisco, Cal.

Paine (Chas.) & Sons, Electrical Engineers, 71, Broadway, New York

Paine, F. B. H., Electrical Engineer, Siemens and Halske Electric Company, 803, Bank of Commerce-bldg, St. Louis, Mo.

Paine, Sidney B., Manager Mill Power Department, General Electric Company, 620, Atlantic-avenue, Boston, Mass.

Paiste, H. T., Maker of the Paiste Switch, 10, South Eighteenth-st, Philadelphia, Pa.; and 341, The Rookery, Chicago, Ill. (*See* Reyrolle (A.) & Co, *in* BRITISH DIVISION)

Palmer Bros, Manufacturers of Dynamos, Motors, &c., Mianus, Conn.

Pan-American Engineering and Supply Company, Electrical and General Engineers, 136, Liberty-st, New York

Parcelle, Albert L., Electrician and Inventor, 157, Washington-st, Boston, Mass.

Pardee, E. T., Electrical Engineer and Contractor, 14, Butler-block, Syracuse, N.Y.

Parks, C. Wellman, Electrician, c/o U.S. Board of Education, Washington, D.C.

Parsell, Henry V., jr., Superintendent of Construction, Edison Decorative and Miniature Lamp Department, Harrison, N.J.

Parshall, H. F., Designing Electrical Engineer, General Electric Company, Lynn, Mass.

Partrick & Carter Company, Manufacturers of and Dealers in Electrical Supplies, 125, South 2nd-st, Philadelphia, Pa.

Pass & Seymour, Manufacturers of China Specialities for Electrical Purposes, Syracuse, N.Y.

Paterson Electrical Manufacturing Company, Makers of Electric Motors, Dynamos, &c., Paterson, N.J.

Patten, F. Jarvis, Consulting Electrical Engineer, 45, Broadway, New York

Patten Motor Manufacturing Company, Makers of the Patten Motor, 45, Lakeside-bldg, Chicago, Ill.

Pattison Bros, Electrical Engineers and Contractors, 136, Liberty-st, New York

Payne (B. W.) & Sons, Makers of the Payne High-Speed Corliss Engine, Elmira, N.Y.; 10, S. Canal-st, Chicago, Ill.; and 45, Dey-st, New York

Pearce, Frederick, Manufacturer of Telegraph and Electrical Instruments, 79, John-st, New York

Pearce, G. Wilfred, Electrical Expert, 44, Murray-st, New York

Pearson, F. J., Electrical Engineer and Expert, Kearney, Neb.

Pearson, F. S., Consulting Electrical Engineer, West End Street Railway Company, 93, Milk-st, and 439, Albany-st, Boston, Mass.

Peck, Edward F., Electrical Engineer and General Superintendent, Citizens Electric Illuminating Company, cor. Rockwell-place and De Kalb-avenue, Brooklyn, N.Y.

Peck, Samuel C., Electrician, Apartado 694, Mexico

Pelton Water Wheel Company, Manufacturers of the Pelton Water Wheel, 143, Liberty-st, New York; and 121, Main-st, San Francisco, Cal.

Peninsular Electric and Engineering Company, Dealers in Electrical Supplies, 97, Ottawa-st, The Grand Rapids, Mich.

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Pennock Battery Electric Light and Improvement Company, Manufacturers of the Pennock Primary Battery and Electrical Apparatus, 334, Dearborn-st, Chicago, Ill.

Pennsylvania Machine Company, Manufacturers of Electrical Apparatus, 29, North Seventh-st, Philadelphia, Pa.

Pennsylvania State College, State College, Centre County, Pa.

Pennsylvania Electrical Engineering Company, Electrical Engineers, Penn Mutual-bldg, Philadelphia, Pa.

Pentz-Reckenzaun Electric Company, Makers of the "Pentz-Reckenzaun" Meter, 1001, Chestnut-st, Philadelphia, Pa.

Pepper & Register, Electrical Engineers and Contractors, 804, Provident-bldg, Chestnut and Fourth-sts, Philadelphia, Pa.

Percival, Geo. J., Electrical Engineer 219, Mermod-Jaccard-bldg, St. Louis, Mo.

Perkins Electric Lamp Co, Manufacturers of the Perkins Incandescent Lamp, 116, Bedford-st, Boston, Mass

Perkins Electric Switch Manufacturing Company, Switch Manufacturers, Hartford, Conn.; and at New York, Chicago, IL, &c.

Perot, L. Knowles, Consulting Electrical Engineer, 308, Walnut-st, Philadelphia, Pa.

Perret, Frank A., Consulting Electrician to the Elektron Manufacturing Company, Springfield, Mass.

Perrine, Dr. F. A. C., Electrician, Professor of Electrical Engineering, Leland Stanford (jr.) University, Palo Alto, Cal.

Perry, Nelson W., Electrical Engineer and Associate Editor of *Engineering Magazine*, 47, Times-bldg, New York

Peru Electric Manufacturing Company, Manufacturers of Electrical Apparatus, Peru, Ind.

Peters, Arthur, A.I.E.E., Electrician, 1722, N. 15th-st, Philadelphia, Pa.

Peterson Electrical Works, Electrical Engineers, 256, Grove-st, Milwaukee, Wis.

Pettingell-Andrews Company, Manufacturers of Electrical Supplies, 192-202, Summer-st, Boston, Mass. (*Pettingell Boston*)

Petty (W. M.) & Co, Dealers in Electrical Supplies, Rutherford, N.J.

Pfannkuche, Gustav, Electrical Engineer and Inventor, 655, Willson-avenue, Cleveland, Ohio

Pfund & Lawton, Makers of Bichromate Plunge Batteries, &c., 153, Broadway, Brooklyn, N.Y. (*Pfund New York*)

Phelps, George M., President *The Electrical Engineer* (incorporated), and Treasurer of the American Institute of Electrical Engineers, 203, Broadway, New York. (*Lengineer New York; 3860 Cortlandt*)

Philadelphia Central Manual Training School, N.E. cor. Seventeenth and Wood-sts, Philadelphia, Pa.

L. F. Rondinella, B.S., M.E. ... ... } Teacher of Constructive Drawing & Electricity

Edwin Partridge, B.S. } Teacher of Physics and Chemistry

Philadelphia Electrical and Manufacturing Company, Electrical Apparatus Manufacturers, 205, Market-st, Philadelphia, Pa.

Phipps, Charles W., Electrical Engineer and Superintendent, Brush Electric Company, Cleveland, O.

Phillips (Eugene F.) Electrical Works, Limited, Manufacturers of Insulated Electric Wire, Providence, R.I. (*See also* COLONIAL DIVISION).

Phillips Insulated Wire Company, Manufacturers of Insulated Wire, Pawtucket, R.I.; and 39-41, Cortlandt-st, New York

Phillips, S. L., Electrical Engineer, Inventor of the "Success" Arc Lamp for Incandescent Circuits, 120, Liberty-st, New York

Phœnix Iron Works Company, Builders of the "Dick and Church" High-speed Engine, Boilers, &c., Meadville, Pa.; 15, Cortlandt-st, New York; and The Rookery, Chicago, Ill. (*Phœnix Meadville*)

Physical Review (monthly), Cornell University, Ithaca, N.Y. (Ann. Sub., $3) (Edward L. Nichols and Ernest Merritt, Editors)

Pickernell, E. A., Chief Engineer and Electrician, Long Distance Telephone Company, 151, Cedar-st, New York

Pierce, Josiah, junior, Civil and Electrical Engineer, 11, South-st, Baltimore, Md.

Pierce and Miller Engineering Company, Electrical Engineers and Contractors, 42, Cortlandt-st, New York

Pierce (O. D.) & Co., Electrical Engineers and Agents, 806, Walnut-st, Philadelphia, Pa. (*863*)

Pinkham Electric Company, Electrical Engineers and Agents, 27, South Eleventh-st, Philadelphia, Pa.

Place, Edwin, Electrical Engineer, Rose Polytechnic Institute, Terre Haute, Ind.

Platt. Jos. C., Consulting Engineer, 35, Wall-st, New York

Plumb (Charles) Electrical Works, Dealers in Electricical Supplies, 89, Erie-st, Buffalo, N.Y. (*639*)

Plume & Atwood Manufacturing Company, Wire Manufacturers, 18, Murray-st, New York; Boston, Mass.; and Chicago, Ill.

Poole, Cecil P., Consulting Electrical Engineer, 108, Eighth-st, Lynchburg, Va.

Poole Electric Company, Makers of the Economic Incandescent Lamp, Lynchburg, Va.

Pope, Franklin L., Consulting Electrical Engineer and Expert, 39-41, Cortlandt-st., New York; and Edgewood Farm, Elizabeth, N.J.

*Pope, Ralph W., Consulting Electrical Engineer (Secretary American Institute of Electrical Engineers, 12, West 31st-st, New York, and 570 Cherry-st, Elizabeth, N.J.

Pope, Read & Rogers, Electrical Experts and Patent Agents, 39-41, Cortlandt-st., New York

Porter Electric Motor Company, Makers of the "Porter" Motor, 62, World bldg, New York; and Jersey City, N.J.

Porter, H. K., Manufacturer of Electrical Apparatus, 66, Beverly-st, Boston, Mass.

Portland General Electric Company, Electrical Engineers and Contractors, cor. Seventh and Alder-sts, Portland, Ore.

Porton, William, Director-General of State Telegraphs, Santiago, Chili

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Postal Telegraph Cable Company, 250, Broadway, New York

Post-Glover Electric Company, Manufacturing Electrical Engineers, 215, West Fourth-st, Cincinnati, O.

Powell (Wm.) Company, Makers of Dynamo and Engine Oilers and Lubricators, Machinists and Engine Builders' Brass Work, 225-231, Spring Grove-avenue, Cincinnati, Ohio (James Powell, President)

Powellton Electric Company, Makers of the Cowling Universal Arc Lamp, 108, S. Fortieth-st, Philadelphia, Pa.

Power (monthly), 145 and 146, World-bldg, New York. (Ann. sub., P.U., $1.50 = 6s. 3d.)

Practical Electricity (fortnightly), 620, Atlantic-avenue, Boston, Mass. (Ann. Sub., P.U., 9s. 6d.)

Premier Electric Company, Manufacturers of Motors, Batteries, and Electrical Specialities, 17 and 19, Whipple-st., Brooklyn, N.Y.

Progressive Age (semi-monthly), 280, Stewart-bldg, Broadway, New York. (E. C. Brown, President and Editor.) (Ann. sub., P.U., 13s. 6d.)

Providence Electric Supply Company, Dealers in Electrical Supplies, Providence, R.I.

Providence Steam Engine Company, Makers of the "Greene" Steam Engine for Electric Lighting purposes, 45, Broadway, New York; and Providence, R.I.

Pullman Electric Company, Manufacturing Electrical Engineers, 44, S. Jefferson-st, Chicago, Ill.

Pumpelly-Sorley Storage Battery Company, Manufacturers of Storage Batteries, 170, South Clinton-st, Chicago, Ill.

Pupin, Dr. Michael I., Consulting Electrical Engineer, Columbia College, 46, West 72nd-st, New York

Putnam (J. E.) & Co., Electrical Engineers and Contractors, 10, Tallman-bldg, 27, East Main-st, Rochester, N.Y. (*951.*)

— Q —

Quaker City Electric Company, Dynamo Makers, 729, Winfield-pl, Philadelphia, Pa.

Queen & Co (Encorporated), Electrical Engineers and Scientific Instrument Makers, 924, Chestnut-st, Philadelphia, Pa. (*Queen Philadelphia*)

Queen City Electric Company, Makers of the Queen City Incandescent Dynamo, Cincinnati, Ohio

Q. and C. Company, Manufacturing Electrical Engineers, 703-707, Phœnix-bldg, Chicago

Quinby, Wm. C., Electric Pump Maker, 59, Liberty-st, New York

— R —

Rabich Fan and Motor Manufacturing Company, Makers of the Rabich Fan-Motor, East St. Louis, Mo.

Rae, Frank B., Consulting Electrical Engineer, 49, Wilcox-st, Detroit, Mich.

Rahue, A. D., Electrical Engineer, Poste Restante, Valparaiso, Chili

Randolph & Clowes, Manufacturers of Brass and Copper Rods and Tubing, Waterbury, Conn.; and at New York and Chicago, Ill.

Randall, John E., Electrical Engineer, Milford, Clermont Co, Ohio

Randolph, L. S., Professor of Mechanical Engineering, Blacksburg, Va.

Randolph, R. J., Electrical Engineer, 425, The Rookery, Chicago, Ill.

Randolph & Sullinger, Electrical Engineers, Nassau Chambers, Nassau-st, New York.

Raper, Chas. Hy., Telegraph Engineer, West Coast of America Telegraph Company, Casilla 49, Lima, Peru

Rasmussen, Einar, Electrical Engineer, Ohio and South Fifth-sts, Quincy, Ill. (*Rasmussen Quincy Ill.*)

Raymond, Chas. W., Civil, Electrical and Mining Engineer, Monte Vista, Col.

Read, Robert H., Electrician and Patent Expert, 41, Cortlandt-st, New York

Reckenzaun, Frederick, Electrical Engineer, 58, Demott-st (P.O. Box 225), West Hoboken, N.J.

Redding (Jerome) & Co, Electrical Engineers, 48, Hanover-st, Boston, Mass.

Reed & McKibbin, Consulting Electrical Engineers and Contractors, 2, Wall-st, New York

Reed (W. S.) & Co., Electric Railway Engineers and Contractors, The Rookery, Chicago, Ill.

Reeve, I. M., Superintendent and Electrician, Citizens Light, Heat and Power Company, Horton, Kansas

Reid, Thorburn, Designing Electrical Engineer, General Electric Company, 24, Chase-st, Lynn, Mass.

Reilly, John C., General Superintendent, New York and New Jersey Telephone Company, 16, Smith-st, Brooklyn, N.Y.

Reinman, Albert L., Electrician, 45, Linden-st, Brooklyn, N.Y.

Reist, H. G., Electrical Engineer, General Electric Company, 11, Baker-st, Lynn, Mass.

Reliance Electric Company, Manufacturers o Electrical Supplies, 720, Sansom-st, Philadelphia, Pa.

Rembof, A., Manufacturer of Electric Light Fittings, 375-381, Kent-avenue, Brooklyn, N.Y.

Remington & Henthorn, Consulting Mechanical and Electrical Engineers, 146, Westminster-st, Providence, R.I.

Rendrock Powder Company, Makers of Electric Batteries, Blasting Materials and Safety Fuses, &c., 23, Park-pl, New York. (*Age bishop New York*)

Revere Rubber Company, Manufacturers of Electrical Supplies, Chelsea, and 63, Franklin-st, Boston, Mass.

Revista Telegrafica de Mexico (semi-monthly), Calle del Refugio 15, Mexico. F. A. Soni, Editor Proprietario. ($5 per annum)

Rhodes Manufacturing Company, Electrical Engineers, Manufacturers of Dynamos, Motors, &c., 918 and 922, Vine-st, Philadelphia, Pa.

R. I. Telephone and Electric Company, Manufacturers of Electrical Supplies, 36, Beverley-st, Providence, R.I.

Rice, Calvin W., Electrical Engineer, Special Motor Department, General Electric Company, Lynn, Mass.

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Rice, Edwin W., jun., Consulting Electrician and Technical Director, General Electric Company, Lynn, Mass.

Richard Elevator Works, Manufacturers of Electric Elevators, **1232, Ridge-avenue,** Philadelphia, Pa.

Rich Electrical **Heating Company, Makers of** Electric Heaters, **Mount Vernon, N.Y.**

Richmond, **W. A.,** Electrician, **Concord, N.H.**

Richter Electric Company, **Dynamo Manufacturers, Camden, N.J.**

Ridlon (Frank) & Co, Dealers in **Electrical** Supplies, 186, Summer-st, **Boston, Mass.**

*RIES, ELIAS E., Electrical Engineer and Inventor, President of the Ries Electric Specialty Company, 7, South Gay-st, and 430, South Broadway, Baltimore, Md. (*Ries Baltimore*)

RIES ELECTRIC SPECIALTY COMPANY (Incorporated), Manufacturers of the **Ries** and Scott Alternating Current Motors and General Electrical Specialities; Patentees and sole Manufacturers of the "Ries" Regulating Sockets and Switches for Alternating Current Incandescent Lamps, &c. Office and Salerooms: 7, South Gay-st, Baltimore, Md.

President .. .. Elias E. Ries
Vice-President .. Lewis S. Greensfelder
Secretary .. .. Leopold Ries
Treasurer .. .. Joseph Miller
Superintendent .. Gordon J. Scott

Ries, Leopold, Secretary **Ries** Electric Specialty **Company** (Incorporated), **7,** South Gay-st, Baltimore, Md.

Riker, **Andrew L., Electrical Engineer, 737, Madison-avenue. New York**

Riker Electric Motor Company, Electrical Engineers, 45 and 47, York-st, Brooklyn, N.Y. (Andrew L. Riker, Electrician)

Ripley, Dwight, Electrical Engineer, 60, Laight-st, New York

Ringler (F. A.) & Co, Electrical **Apparatus Manufacturers, 21, Barclay-st, New York**

River Plate Electricity Company, Limited—*See* Compañia de Electricidad del Rio de la Plata, *and also* BRITISH DIVISION)

River Plate Telegraph Company, Limited, Montevideo, and Buenos Ayres, S. America. (John Oldham, Manager, Montevideo). (*See also* BRITISH DIVISION)

Robbins Electric Company, Electrical Engineers and Contractors, 39, Sixth-avenue, Pittsburg, Pa.

Robb, Russell, Electrical **Engineer, Stone and Webster,** 4, Post Office-sq, **Boston, Mass.**

Roberts-Brevoort Electric Company, Makers of the Roberts Batteries, 208, Broadway, New York

Roberts (E. P.) & Co, Electrical and Mechnical Engineers, Brainard Block, Cleveland, O.

Roberts, Prof. N., Consulting Electrician, Swan Lamp Company, Cleveland, O.

Robertson's Lead Incasing Works, Wire and Cable Coverers, 131, Water-st, Brooklyn, N.Y.

Robertson (A. C.) Co, **Electrical Engineers,** Wilkesbarre, Pa.

Robinson, Almon, Expert in Methods of Gearing, P. O. Box 843, Lewiston, Me.

Robinson, E. M, Electrical Engineer, P.O. Box, 151, Columbus, Ga.

Robinson and Carey Company, Dealers in Electrical Apparatus, St. Paul, Minn.

Robinson Electric Company, Electrical Engineers, 478, Broadway, Albany, N.Y.

Robinson (J. K.) & Co, **Dealers in Electrical Supplies, 146, Franklin-st, Boston, Mass.; and 18, Broadway, New York**

Robinson Machine Company, Manufacturers of Electrical Machinery, Altoona, Pa.

Rockford Electric Manufacturing Company, Manufacturers of Electrical Apparatus, Rockford, **and 451,** The Rookery, **Chicago,** Ill.

Rockwood Manufacturing Company, **Manufacturers of the "Pyle" Engine and Dynamo,** Indianopolis, Ind.

Rodgers, Howard S., Electrical Engineer, Eddy Electric Manufacturing Company, Windsor, Conn.

Rodman, Samuel, jr. Electrician and Expert in High Explosives, 17, Quincy-st, Chicago. Ill.

Rodrigues, M. R. Manufacturer of Electrical Specialties, 17, Whipple-st, Brooklyn, N.Y.

Roebling's (John A.) Sons Company, Wire Makers, Trenton, N.J.; and **at** Chicago, Ill., New York; **and** San Francisco, Cal.

Roessler & **Hasslacher** Chemical **Company,** Manufacturers of **Insulating Materials, 73, Pine-st, New York,** (*Vigda New York*)

Rogers Laboratory of Physics, Massachusetts Institute of Technology, Boston, Mass.

Rohrer, **A. L.,** Electrical Engineer, **General** Electric Company, *Schenectady,* **N.Y.**

Roller, Lieut. John E. Superintendent of Electrical Department, U. S. Navy Yard, New York

Rondinella, L. F., Electrical Engineer, 705, Chestnut-st, Philadelphia, Pa.

Rose Electric Light Supply Company, Makers of the Excelsior Dynamos, 1106, Pine-st, St. Louis, Mo.

Rose Polytechnic Institute, Terre Haute, Ind.

W. A. Noyes, Ph.D. Prof. of Chemistry
M. A. Howe, C.E. Prof. Civil Engineering
Thomas Gray, B.Sc. .. .. .. } Prof. of Dynamic Engineering
C. L. Mees, M.D. Prof. of Physics

Rosenbaum, William A., Electrical Engineer and Patent Agent, 177, Times-bldg, New York.

*Rowland, Henry A., Ph.D., Professor of Physics and Director of the Physical Laboratory, Johns Hopkins University. 915, Cathedral-st, Baltimore, Md.

Royal Columbian Electric Company, Dynamo Makers, 53, Dearborn-st, Chicago, and Peoria, Ill.

Royal Arc Electric Company, Makers of the "Marks" Incandescent Arc Lamp, 143, Liberty-st, New York

Royal Electric Company, **Manufacturing** Electrical Engineers, 909 and 911, South Washington-st, Peoria, Ill. (G. Luthy, Manager)

Royal Electrical Specialty Company, Manufacturers of Insulators and Electrical Specialities, 239, Water-st, New York

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Royce & Marean, Dealers in Electrical Supplies, 1410, Pennsylvania-avenue, Washington, D.C. (*See*)

Rushmore, S. W. Manufacturing Electrical Engineer, 24, Morris-st, Jersey City, N. J.; and 89, Liberty-st, New York

Russell, Charles, Maker of the Russell Dynamo, 18, S. Broad-st, Philadelphia, Pa.

Russell Electric Lamp Company, Manufacturers of the Baby Arc Lamp, Portland, Me.

Russell Electrical Manufacturing Company, Electrical Engineers and Contractors, 212, Eddy-st, Providence, R. I.

Russell & Officer, Electrical Engineers, 1735, Champa-st, Denver, Colo.

*Ryan, Harris J., Professor of Electrical Engineering, Dibley, College, Cornell University, and 31, Dryden-rd, Ithaca, N.Y.

Ryan and Macdonald Construction Company, Electrical Engineers, Baltimore, Md.

Ryland-Robinson Electric Supply Company, Manufacturers of Storage Batteries, 723, Market-st, San Francisco, Cal.

— S —

Saavedra, Bénard y Ca., Electrical Agents, Contractors for Electric Lighting and Electric Railways, Casilla, 556, Valparaiso, Chili (*Bénard Valparaiso*)

Safety Electrical Company, Contractors for and Manufacturers of Electrical Specialities, 88, Mechanic-st, Newark, N.J.

Safety Electric Railway and Power Company, Electric Railway Engineers and Contractors, 45 and 47, Wall-st, New York.

Safety Insulated Wire and Cable Company, Manufacturers of Insulated Wires, 234, West Twenty-ninth-st, New York

St. Louis Battery Manufacturing Company, Makers of Telegraph, Telephone, and Fire Alarm Materials, and Electric Bells, Batteries, &c., 707, Locust-st, St. Louis, Mo.

Salem Battery Company, Manufacturers of Primary Batteries, Salem, Va.

San Francisco Electric Storage Company, Manufacturing Electrical Engineers, San Francisco, Cal.

Sargent (F.) & Lundy (A. D.), Electrical and Mechanical Engineers, 1421, Monadnock-bldg, Chicago, Ill.

Sawtell Electric Company, Electrical Engineers, 10, Shawmut-bldg, 146, Franklin-st, Boston, Mass.

Sawyer, Frederick J., Consulting Electrical Engineer, 381, Boylston-st, Boston, Mass.

Sawyer-Man Electric Company, Electric Light Engineers and Contractors, 620, Atlantic-avenue, Boston, Mass.; and at Chicago, Ill., and New York

Schaefer Electric Manufacturing Company, Manufacturers of the Schaefer Dynamo and Lamps, Boston, and Cambridgeport, Mass.

Scheible, Albert, Electrical Engineer, 851, The Rookery, Chicago, Ill.

Schefbauer & Co, Electrical Engineers and Manufacturers of the "Acme" Arc Lamp, 28 and 32, Centre-st, New York

Schieren (Charles A.) & Co, Leather Belting Manufacturers, 46, South Canal-st, Chicago, Ill.; and New York

Scholl (Julian) & Co, Consulting Electrical Engineers, 126, Liberty-st, New York

School of Mines Quarterly, School of Mines, New York

Schrader, Dr. William, Professor of Electrical Engineering, University of Missouri, Columbia, Mo.

Schultz (G. W.) & Co, Dealers in Electrical Apparatus, 308, Walnut-st, Philadelphia, Pa.

Schulze-Berge, Franz, Electrical Engineer, 44, Monroe-pl, Brooklyn, N. Y.

Schuyler Electric Company, Makers of the Schuyler System of Arc Lighting, Middletown, Conn.

Schuyler, S. S., Electrical Engineer, 45, Broadway, New York

Schwindt & Edelkamp, Manufacturers of Primary Batteries, 610, Eighth-avenue, New York.

Scientific American (weekly), 361, Broadway, New York. (Ann. sub., $3; Europe $4.) (Also *Architect and Builders' Edition*, $2 20c.; Europe, $3 50c.)

Scientific American Supplement (weekly), 361, Broadway, New York. (Ann. sub., $5; Europe, $6.)

Scott, Campbell, Electrical Engineer and Dealer in Electrical Apparatus, Commerce-bldg, Louisville, Ky.

Scott Electrical Manufacturing Company, Manufacturers of Arc Lamps and Electrical Apparatus, 89, Liberty-st, New York

Scott, George B., Electrician, 16, Broad-st, New York

Scott, Gordon, J., Superintendent, Ries Electric Specialty Company (Incorporated), 7, South Gay-st, Baltimore, Md.

Scott, Lewis, Electrical Engineer, 7, South Gay-st, Baltimore, Md.

Seafert (William) & Co, Electric Light and Power Contractors (the Seafert Electrical System), 159 and 161, La Salle-st, Chicago, Ill.

Sebastian Lathe Company, Machinists and Tool Makers, 121-123 Culvert-st, Cincinnati, O.

Sechrist (Albert) & Co, Electrical Engineers, Denver, Col.

Security Insulator Company, Manufacturers, of Insulators, 136, Liberty-st, New York

See (A. B.) Manufacturing Company, Electrical Engineers, 966½, Bergen-st, Brooklyn, N. Y.

Seeley (Elisha B.) & Co, Electrical Engineers, 1226, Chestnut-st, Philadelphia, Pa.

Seeley, John A., Electrical Engineer and Contractor, 121, Liberty-st, New York

Seely and Taylor Manufacturing Company, Electrical Engineers and Agents, 24, Cortlandt-st, and 19, Dey-st, New York

Seib & Starke, Manufacturing Electricians, 411 and 413, East 107th-st, New York

Seitzinger, H. M., Consulting Engineer, Wilkesbarre, Pa.

Sellers (W.) & Co, Electric Crane Builders, Philadelphia, Pa. (*Sellers Philadelphia*)

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Sessions, E. O., Electrical Engineer, Concord, N.H.

Serrell, Lemuel Wm., M.E., Consulting and Constructing Electrical and Mechanical Engineer, 10, Wall-st, New York

SHAIN, CHAS. D., Electrical Engineer, Agent for the Siemens and Halske Electric Company of America, 136, Liberty-st, New York

*Shallenberger, O.B., Chief Electrician, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

Shaughnessy, Frank, Electrical Expert, Depot-st, Concord, N.H.

Shaver Corporation, Makers of the Shaver Multiplex Telephone, 78, Cortlandt-st, New York

Shaw Electric Crane Company, Makers of Electric Cranes, Muskegon, Mich.

Shaw (J. Elliott) & Co, Dealtrs in Electrical Supplies, 632, Arch-st, Philadelphia, Pa.

Shawhan-Thresher Electric Company, Manufacturers of Motors, Dynamos, &c., Dayton, O.

Sheble, Franklin, Electrical Engineer, Railway Engineering Department, General Electric Company, Lynn, Mass.

Sheddy, J. H., Manager and Electrician, Renovo Edison Light, Heat and Power Company, Renovo, Pa.

*Sheldon, Samuel, A.M., Ph.D., Professor of Physics and Electrical Engineering, Polytechnic Institute, and 170, State-st, Brooklyn, N.Y.

Shepard & Searing, Mechanical and Electrical Engineers, 513 and 514, Mining Exchange, Denver, Colo.

Shephardson, Professor George D., Electrician and Professor of Electrical Engineering, University of Minnesota, Minneapolis, Minn.

Short Electric Railway Company, Constructors of Electric Railways, Cleveland, Ohio; and at New York, and Chicago, Ill.

Sibley (C. C.) & Co, Manufacturers of Electric Lamps, Motors, Dynamos, Switches, &c, 416-418, West Twenty-sixth-st, New York

Sickles, E. C., Professor of Electrical Engineering, Highland Park Normal College, Des Moines, Iowa

Siegrist (J. H., jun.) & Co., Manufacturers of Electric Light Plants, &c, 313, Olive-st, St. Louis, Mo.

Siemens and Halske Electric Company, Manufacturers of Electrical Apparatus, Monadnock-bldg, Chicago, Ill.; and at New York, Cincinnati, O., &c. (O. W. Meysenberg, President; A. W. Wright, Secretary)

Simmons (John) Company, Manufacturers of Electric Light Fittings, 110, Centre-st, New York

Simons (M. W.) Electric Company, Manufacturers of Electrical Apparatus, Plymouth, Ind.

Simplex Electrical Company, Makers of the Simplex Electric Wire, 75-78, Cornhill, Boston, Mass. (*Innosam Boston, 2694*)

Simpson Electric Manufacturing Company, Makers of the Simpson Dynamo and Motor, 39 41, West Washington-st, Chicago, Ill.

Sioux City Electrical Supply Company, Brass Founders, Manufacturers of and Dealers in Electrical Supplies, Hunt School-bldg, Sioux City, Iowa.

Slade, Frank N., Engineer, Independent Electric Company, Chicago, Ill.

Slade (H. L.) & Co, Electrical Engineers, 134, Congress-st, Boston, Mass.

Slater, Henry B., M.S., Electrical Engineer, Vice-President and Manager, Canon City Electric Light and Power Company, Canon City, Colo. (*12*)

Slater, Wm., Representative of the Western and Brazilian, and Brazilian Submarine Telegraph Companies, Casilla 1164, Buenos Ayres, Argentine Republic

Sloss-Stein Electric Company, Manufacturers of Electrical Apparatus, 85, Dearborn-st, Chicago, Ill.

Smith, Frederick H., Civil and Electrical Engineer, 227, East German-st, Baltimore, Md.

Smith, Harold B., Professor of Electrical Engineering, Purdue University, Lafayette, Ind.

Smith (Harry S.) & Co, Limited, Electrical Contractors and General Agents, 607, Chestnut-st, Philadelphia, Pa. (*1058*).

Smith, J. Elliott, Telegraph Engineer, Superintendent Fire Alarm Telegraphs, 122, West Seventy-third-st, New York

Smith, Jesse M., Mechanical and Electrical Engineer, Expert in Patent Causes, 36, Moffatt-block, Detroit, Mich.

Smith & Shaw Electric Company, Manufacturers of Electrical Apparatus, 610, Eighth-avenue, New York

Smith, R. B., Consulting Electrical Engineer, Atlantic-bldg, Washington, D.C.

Smith, T. Carpenter, Mechanical Engineer and Electrician, M. R. Muckle, jun., & Co, 212, Drexel-bldg, Philadelphia, Pa. (*1306*)

Smith, Thos. G., jun., M.E., Consulting Electrical Engineer, 11, Hammond-bldg, Cincinnati, O.

Smith, T. Jarrard, Electrician and Manager Electrical Department, E. S. Greeley Company, 5 and 7, Dey-st, New York

Smith & Wallace, Manufacturers of and Dealers in Electrical Supplies, 8, Oliver-st, Boston, Mass.

Smyth, C. A., Storage Battery Manufacturer, Front and Locus-sts, Momence, Ill.

Snow and Starkie, Electric Motor Makers, Hartford, Conn.

Société Française des Telegraphes Sous-Marins, Port au Prince, St. Marc, Gonaives, &c., Hayti. (*See also* CONTINENTAL DIVISION)

Société anonyme de Travaux et d'Enterprises au Brésil, Machinery Shippers, 81, Rua Primero de Março, Rio de Janeiro.

Solar Carbon and Manufacturing Company, Makers of Carbon Brushes, Electric Light and Battery Carbons, 95, Fifth-avenue, Pittsburg, Pa.

Soni, F. A., Electrician, 31, Apartado en el Correo, Mexico

Sorley, Charles, Storage Battery Expert, 1,563, Monadnock-bldg, Chicago, Ill.

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South-Western Electrical Supply Company, Manufacturers of Electrical Supplies, 910 and 911, New York Life-bldg, Kansas City, Mo.

Southern Electric Company, Manufacturers of Electrical Apparatus, Hoen-bldg, 201-203, North-st, Baltimore, Md.

Southern Engineering Company, Electrical and Mechanical Engineers, 246, Fifth-st, Louisville, Ky. (*2050*)

Southern Electrical Manufacturing and Supply Company, Limited, Electrical Apparatus Makers, 111, Baronne-street, New Orleans, La.

Southern Electrical Supply Company, Dealers in Electrical Supplies, 11, South 7th-st, St. Louis, Mo. (*981*)

Spaulding, Hollon C., Electrical Engineer, Nashua, N.H.

Spengel, C., Patent Expert and Solicitor, 75, West Fourth-st, Cincinnati, Ohio

Sperry Electric Company, Electrical Engineers and Makers of the Sperry Dynamo, 195-207, Canal-st, Chicago, Ill.

Sperry Electric Mining Machine Company, Makers of Electric Mining Motors, 39th-st and Stewart-avenue, Chicago, Ill.

Sperry Electric Railway Company, Electric Traction Engineers and Contractors, Mason and Belden-sts, Cleveland, O.

Sperry, Elmer A., Electrical Engineer, Mason and Belden-sts, Cleveland, O.

Sprague, Duncan, and Hutchinson, Limited, Consulting Electrical Engineers and Experts, 15, Wall-st, New York; Baltimore, Md.; and Bridgeport, Conn. (Manager, A. B. Mason.) (*Spragdunc New York, 435 Cortlandt*)

Sprague Electric Elevator Company, Manufacturers of Electric Cranes and Lifts, Postal Telegraph-bldg, Broadway and Murray-st, New York

*Sprague, Frank J., Electrical Engineer, Sprague, Duncan, and Hutchinson, 15, Wall-st, and 182, West End Avenue (*Spragdunc New York*), New York

Springfield Motor and Switch Company, Manufacturers of Electrical Apparatus, Middletown, Conn.

Standard American Electric Company, Electrical Engineers, 140, Winchester-avenue, New Haven, Conn.

Standard Battery Company, Makers of the Standard Gravity Battery, 334, Dearborn-st, Chicago, Ill.

Standard Electric Company, Makers of the "Standard" Dynamo and Arc Lamp, 625, Home Insurance-bldg, and (Works) 313-317, South Canal-st, Chicago, Ill.

Standard Electric Company, Makers of Batteries, Dynamos, &c., Detroit, Mich.

Standard Electric Company, Makers of the Standard Cyclone Fan Motor, 2246 and 2248, North Ninth-st, Philadelphia, Pa.

Standard Electric Company of Vermont, Electrical Engineers and Contractors, St. Johnsbury, Vermont

Standard Electric Equipment Co., General Electrical Contractors, 67, Grand-st, New York

Standard Electric Manufacturing Company, Manufacturers of Electric Light Apparatus, 4, Liberty-st, Boston, Mass.

Standard Electric Supply Company, Manufacturers of Electrical Instruments and Supplies, 180, Summer-st, Boston, Mass.

Standard Electrical Works, Manufacturing Electrical Engineers, 161-165, West Pearl-st, Cincinnati, Ohio. (*Standard Cincinnati*)

Standard Lamp and Motor Company, Manufacturers of the "Standard" Incandescent Lamp, Oconto, Wis. (Emil L. Oppermann, Manager)

Standard Underground Cable Company, Makers of Cables, Insulated Wires, &c., Westinghouse-bldg, Pittsburg, Pa.

Stanley Electric Manufacturing Company, Electrical Apparatus Makers, Pittsfield, Mass.

Stanley, William, Electrician, Pittsfield, Mass.

Star Electric Company, Electrical Engineers and Contractors, Dubuque, Ia.

Star Electric Lamp Company, Makers of the "New Sunbeam" Incandescent Lamp, 102, Michigan-avenue, Chicago, Ill.

Star Electrix Company, Manufacturers of Electrical Fittings, 1308, Filbert-st, Philadelphia, Pa.

Starr Electrical Company, Manufacturers of Electrical Apparatus, 6, Wall-st, New York

Stern & Silverman, Electrical Engineers and Contractors, 707, Arch-st, Philedelphia, Pa.

Stanton, C. H. & H., Electrical Engineers and Contractors, 132-134, South Third-st, Philadelphia, Pa.

Stearn, C. P., Consulting Electrical Engineer and Professor of Electricity, Buffalo School of Electricity, Buffalo, N.Y.

Stearns Manufacturing Company, Manufacturers of the "Woodbury" High Speed Steam Engine, Erie, and Philadelphia, Pa.

Stebbins, Theodore, Superintendent of Railway Construction, General Electric Company, 44, Broad-st, New York. (*3056*)

Steel Motor Company, Manufacturers of Electrical Machinery, Cleveland, Mo.

Steele and Johnson Manufacturing Company, Manufacturers of Brass Goods for Electrical purposes, Waterbury, Conn.; and 35, Howard-st, New York

*Steinmetz, Charles P., Electrical Engineer, General Electric Co, Lynn, Mass.

Stellar Electric Company, Manufacturers of Incandescent Lamps, &c., 13, Doane-st, Boston, Mass.

Stephens-Miles Electric Company, Manufacturing Electrical Engineers, 181, Elm-st, Cincinnati, O.

Stern Incandescent Lamp Company, Makers of the "Stern" Incandescent Lamp, Buffalo, N.Y.

Steuben Incandescent Lamp Company, Makers of the "Steuben" Incandescent Lamp, Canisteo, N.Y.

Stevens Institute of Technology, Hoboken, N.J. (President, Henry Morton, Ph. D.)

Stevenson-Hoggson Electric Company, Manufacturers of Electrical Apparatus, 919, Olive-st, St. Louis, Mo.

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Steward (D. M.) Manufacturing Company, Manufacturers of Lava Insulators, Chattanooga, Tenn.

Stilwell-Bierce and Smith-Vaile Company, Manufacturers of Turbines, &c., Dayton, Ohio; and at New York and Chicago, Ill. (*Stilwell Dayton Ohio, 265*)

Stillwell, Lewis B., Electrical Engineer, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

Stine, Dr. W. M., Electrical Engineer, Professor of Electricity, Armour Institute, and Editor of *Electrical Engineering*, The Rookery, Chicago, Ill.

Stockbridge, George H., Patent Attorney and Electrical Expert, 39, Cortlandt-st, New York. (*Legitimist N.Y.*)

Stoelting (H. C.) Manufacturing Company, Manufacturers of Electrical Apparatus, 62-66, S. Canal-st, Chicago, Ill.

Stokes and Parrish Elevator Company, Makers of Electric Cranes, Bullitt-bldg, and Works) 30th and Chestnut-sts., Philadelphia, Pa.; and 136, Liberty-st, New York

Stone & Webster, Electrical Engineers, 4, Post Office-sq, Boston, Mass.

Storage Battery Supply Company, Dealers in Storage Batteries and Electrical Apparatus, North-East cor. 23rd-st, and First-avenue, New York

Storey Motor and Tool Company, Makers of the "Storey" Motor, 120, Liberty-st, New York

Storrs, Prof. H. A., Consulting Electrical Engineer, 111, E. 24th-st, New York

Stow Manufacturing Company, Makers of Electric Motors, Binghampton, N.Y.

Street Railway Gazette (weekly), Monadnock-block, Chicago, Ill.; and 171, Broadway, New York. (Edward Caldwell and J. W. Dickerson, Editors.) (Ann. sub., P.U., $5.)

Street Railway Journal (monthly), Havemeyer-bldg, New York. (Ann. sub., P.U., $6 = £1 2s.)

Street Railway News (weekly), 12-13, World-bldg, New York. (Ann. Sub., $4 = 16s. 9d.) (*Electage New York, 2361*)

Street Railway Review (monthly), 269, Dearborn-st, Chicago, Ill. (H. H. Windsor, Editor.) (Ann. sub., U.S., $2; P.U., 20s.

Stucky & Heck Electrical Manufafacturing Company, Electrical Engineers, 23, N. J. Railroad-avenue, Newark, N.J.

Sturges, William M., Consulting Electrical Engineer, 22, Main-st, Utica, N.Y.

Sturtevant (B. F.) Company, Makers of the Sturtevant Blowers, &c., Jamaica Plain, Boston, Mass.

Sullivan, M. J., Electrician, Chicago Representative of the *Electrical World*, 936, Monadnock-block, Chicago, Ill.

Sun Arc Light Company, Manufacturers of Arc Lamps and Electrical Supplies, 203, South Canal-st, Chicago, Ill.

Sunbeam Incandescent Lamp Company, Manufacturers of Incandescent Lamps, 102, Micigan-avenue, Chicago, Ill.

Sutton-Steele Electric Manufacturing Company, Dynamo Makers, Dallas, Texas

Swain Turbine Manufacturing Company, Manufacturers of Turbines, Lowell, Mass.

Swan Lamp Manufacturing Company, Makers of Incandescent Lamps, Cleveland, Ohio

Swan, F. A., Electrical Engineer, 194, Summer-st, Boston, Mass.

Swaney Electric Company, Manufacturers of Electrical Apparatus, East Liverpool, O.

Sweet, Henry N., Electrician and Chief of Patent Bureau, Thomson Electric Welding Co, Lynn, Mass.

Swift (H. E.) Manufacturing Company, Electrical and Mechanical Engineers, 1, Hartford-st, Boston, Mass.

Syracuse Electrical and Manufacturing Company, Electrical Engineers and Contractors, East Washington-st, Syracuse, N.Y.

Syracuse Storage Battery Company, Makers of the Syracuse Storage Battery, Syracuse, N.Y. (R. V. Miller, President; C. L. Pack, Secretary)

Syracuse Twist Drill Company, Makers of Engineers' Tools, Syracuse, N.Y.

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Taintor, Giles, Electricial Engineer and Division Superintendent, New England Telephone and Telegraph Company, Springfield, Mass.

Talcott, Wm. M., Electrical Engineer and Contractor, 58, Traders-Bldg, 6-10, Pacific-ave, Chicago, Ill.

Tapley, Walter H., Electrician in charge of Government Printing Office, c/o Public Printer, Washington, D.C.

Tatham & Bros., Electricians, Makers of Electric Wires and Cables, 226, South Fifth-st, Philadelphia, Pa.

Taylor Battery Company, Battery Makers, 51, Dey-st, New York. (*Turnpike New York*)

Taylor, Dee & Mack, Dealers in Electrical Supplies, 348, Dearborn st, Chicago, Ill.

Taylor & Walsh, Electrical Engineers, 100, South Fifth-avenue, New York

Technic Electrical Works, Manufacturers of Electrical Apparatus, Provident-bldg, Philadelphia, Pa.

Technology Quarterly, issued by the Society of Arts of the Massachusetts Institute of Technology, Boston, Mass. (Ann. sub., $3)

Teeple Electrical Construction Company, Manufacturers of Electrical Apparatus, 136, Liberty-st, New York

Terry, Charles A., Electrical Patent Lawyer, Westinghouse Electric and Manufacturing Company, 120, Broadway, New York (*Converter Pittsburgh*)

Tesla Electric Light Manufacturing Company, Makers of the Tesla Dynamo, Railway, N.J.

*Tesla, Nikola, Electrical Engineer and Inventor, The Gerlach, 55, West Twenty-seventh-street, New York

Texas Electric Brokerage Company, Dealers in Electrical Supplies, North Texas National Bank-bldg, Dallas, Texas

Thomas, Benjamin F., Electrician and Professor of Physics, Ohio State University, Columbus, O.

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Thomas & Kellogg, Manufacturing Electrical Engineers, 1006, Pentia-bldg, and (Works) Chicago Heights, Chicago, Ill.

Thomas (R.) & Sons Company, Manufacturers of Switches, Cut-Outs &c., East Liverpool, O.; 136, Liberty-st, New York; and 7, Arch-st, Boston, Mass.

Thompson, Crawford & Co, Electric Railway Engineers and Contractors, World-bldg, New York

Thompson, Edward P., M.E., Patent Attorney and Consulting Electrician, 3-9, Beekman-st, New York. (*Science New York*)

Thompson & Robertson, Makers of the "Fibrous" Dry Battery, 261, Broadway, New York

Thomson Electric Welding and Projectile Company, Lynn, Mass. (Elihu Thomson, Consulting Electrician; Hermann Lemp, Electrician)

*Thomson, Prof. Elihu, Inventor and Electrician, Lynn, Mass.

Thomson-Houston International Electric Company, Edison-bldg, 44, Broad-st, New York. (*See also* BRITISH *and* CONTINENTAL DIVISIONS)

Thurston (Geo. H.) & Co, Electrical Engineers, 59, South Main-st, Providence, R.I.

Thwing Electric Company, Makers of Electrical Apparatus, Lake and Peoria-sts, Chicago, Ill.

Tice-Lintner Electric Company, Manufacturers of Electrical Apparatus, Edison-bldg, Minneapolis, Minn.

Ticonderoga Machine Company, Manufacturers of Electrical Machinery, Ticonderoga, N.Y.

Tilly and Van Hagen Company, Primary Battery Manufactureqs, 879, Gates-ave, Brooklyn, N.Y.

Tobey, William Boardman, Electrical Engineer, Stanley Laboratory Company, Pittsfield, Mass.

Tod-Applegate Company, Makers of Electrical Apparatus, 313-315, Dearborn-st, Chicago, Ill.

Toledo Electric Heating Company, Makers of Electric Heating Apparatus, Toledo, O.

Tompkins, S., Professor of Mechanical and Electrical Engineering, Clemson College, Fort Hill, S.C.

Townsend, Henry C. Electrical Patent Expert, 5, Beekman-st, New York

Transactions of the American Institute of Electrical Engineers (monthly), 12, West Thirty-first-st, New York. (Ann. sub., $5. = £1 1s.)

Traphagen, Baker & Co, Incandescent Lamp Makers, 251, Market-st, Newark, N.J.

Trenton Electrical Construction Company, Manufacturers of Electrical Apparatus, Trenton, N.J.

Trippe, Charles, Superintendent Anglo-American Telegraph Company, St. Pierre Miquelon, Newfoundland

Triumph Compound Engine Company, Makers of the "Triumph" Engines, Dynamos and Motors, Cincinnati, O.

Tropp, B., Electrician, 101, East Ninetieth-st, New York

Troy Electric Dynamo Company, Manufacturers of the Winkler Dynamo, 553, River-st, Troy, N.Y.

Tucker Electrical Construction Company, General Electrical Contractors. 14-20, Whitehall-st, New York. (*1776 Cortlandt*)

Tucker & Hall, Electrical Engineers and Contractors, 432 and 434, Electrical Exchange-bldg, New York

Tucker, W. H., Electrical Engineer and Contractor, 432 and 434, Electric Exchange-bldg, New York

Turbayne-Tamblyn Company, Makers of the "Turbayne" Arc Lamp, 66-70, East Fort-st, Detroit, Mich.

Turner, W. S., Electrical Engineer (Woodbridge & Turner Engineering Co,) 47, Times-bldg, New York

Tyndall, William D., Lawyer and Patent Expert, 170, Broadway, New York

— U —

Uebelacker, Charles F., Electrical Engineer, E. P. Roberts Company, Western Reserve bldg, Cleveland, Ohio

Uhlenhaut, Fritz, jun, Electrical Engineer, Philadelphia Traction Company, 4101, Haverford-st, Philadelphia, Pa.

Ulary, W. A., Manufacturer of Electrical Apparatus, 1018, Chesnut-st, Philadelphia, Pa.

Union Electric Constructing Company, Electrical Engineers and Contractors, 312, North Eleventh-st, St. Louis, Mo.

Union Electric Works, Dealers in Electrical Apparatus, &c., 506, Springer Block, 207, South Canal-st, Chicago, Ill

Union Electric Company, Manufacturers of Storage Batteries, 45, Broadway, New York; and (Works) Orangeburgh, N.Y. (S. R. Bradley, Junr, Secretary) (*4379 Cortlandt*)

Union Electric Manufacturing Company, Manufacturers of Electrical Apparatus, Bridgeport, Conn.

Union Porcelain Works, Makers of Hard Porcelain Insulators, 300, Eckford-st, Brooklyn, N.Y.

Union Telephone Electric Manufacturing Company, Manufacturers of Telephone Instruments, 64 and 66, Broadway, New York

United Columbian Electric Company, Manufacturers of Dynamos, Motors, and Batteries, Camden, N.J.

United Electric Company, Dealers in Electrical Apparatus and Supplies, Salt Lake City, Utah; and 40, Wall-st, New York.

United Electric Improvement Company, Electrical Engineers, 838, Drexel-bldg, Philadelphia, Pa, and Gloucester, N.Y.

United Gas Improvement Company, Electric Light Engineers, Drexel bldg, Cor. Chestnut and Fifth-sts, Philadelphia, Pa.

United River Plate Telephone Company, Limited, 26, Calle San Martin, Buenos Ayres. (*See also* BRITISH DIVISION)

United States Electric Lighting Company (Westinghouse Electric Company, Lessees), Makers of the U.S. System of Electric Lighting, 120, Broadway, New York

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Universal Arc Lamp Company, Makers of the Universal Arc Lamp, Edison-bldg, 42 and 44, Broad-st, and 49, Twenty-second-st, New York.

Universal Electric Company, Electrical Engineers, Equitable-bldg, and Broad-st, Boston, Mass.; and at Portland, Me.

Universal Electric Company, Manufacturing Electrical Engineers, 739-741, Cedar-avenue, Cleveland, O.

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Unwin, A. H., Engineer and Manager, Compañia Electricidada del Rio de la Plata, Limitada, Casilla 137, Rosario de Santa Fé, Argentine Republic

Utica Electric Manufacturing Company, Manufacturers of Electrical Supplies, Utica, N.Y.

V

Vail, Stephen, Electrician, 18, Cortlandt-st, New York

Vail, W. A., Manufacturer of Storage Batteries, 136, Liberty-st, New York

Van Buren, Gurdon C., Electrician, 5, Wilson-st, Albany, N.Y.

Vance, A. St. Clair, Electrical Engineer, General Superintendent H. Ward Leonard & Co, 136, Liberty-st, New York

Van Nostrand (D.) Company, Publishers of Electrical and Scientific Books, 23, Murray-st, and 27, Warren-st, New York. (*Bowline New York*)
Electrical Publications a Speciality.

Van Nuis, C. S., Maker of the Ajax Switch, 136, Liberty-st., New York.

Van Vleck, Frank, President Van Vleck Tramway Company, Wells Fargo-bldg, Los Angeles, Cal.

Varley Duplex Magnet Company, Manufacturers of Electrical Apparatus, 64, Cortlandt-st, New York

Varley, Richard, Junr, Electrical Expert, 64, Cortlandt-st, New York

Vermeule, C. C., Consulting Civil and Electrical Engineer, 71, Broadway, New York

Viaduct Manufacturing Company, Makers of Electrical Supplies, Telephone-bldg, Baltimore, Md.; and 95, Broad-st, New York

Volta Eclipse Electrical Manufacturing and Supply Company, Electrical Engineers, 230, Main-street, Memphis, Tenn.

Vosburgh (W. C.) Manufacturing Co, Limited, Manufacturers of Electric Light Fixtures, 269-281, State-st, Brooklyn, N.Y.

Voss, D. C., Maker of the "Voss" Incandescent Lamp, Niles-bldg, Boston, Mass.

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W

Wachtel (Charles) Electrical Manufacturing Company, Electrical Engineers and Makers of the "Wachtel" Dynamo, Newark, N.J.

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Wagner Electric Manufacturing Company, Makers of the Wagner Alternating-Current Motors, Transformers, &c., 2017-2023, Locust-st, St. Louis, Mo. (H. A. Wagner, Manager)

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Waite and Bartlett Manufacturing Company, Manufacturers of Electro Medical Instruments, 143, East Twenty-third-st, New York

Wakefield Electrical Engineering Company, Electrical Engineers, 731, Reading Terminal, Philadelphia, Pa.

Waldo, Dr. Leonard, Electrical Engineer, Sprague, Duncan and Hutchinson, Ltd., Bridgeport, Conn.; and 15, Wall-st, New York

Waldo & Stout, Manufacturers of Electrical Machinery Castings, Bridgeport, Conn.

Walker Electric Company, Makers of the Walker Electric Meter and Electrical Supplies, 50, Broadway, New York

Walker, F. Philip, Telegraph Engineer, Central and South American Telegraph Company, Casilla 729, Valparaiso

Walker, Geo. W., Electrical Expert, General Electric Company, Edison-bldg, Broad-st, New York

Walker Manufacturing Company, Manufacturers of Electric Motors, Cleveland, O.

Walfield (S. D.) Company, Electrical Engineers, 336, North-st, Baltimore, Md.

Wallace, Geo. S., Electrical Engineer, Manager, Chesspeake and Ohio Railway Company, Box 12, Hinton, O.

*Ward, G. G., Vice-President and General Manager, Commercial Cable Company, 1, Broadway, New York. (Local Hon. Secretary of the Institution of Electrical Engineers)

Waring Electric Company, Makers of the "Novak" Incandescent Lamp, Manchester, Conn.; and 116, Bedford-st, Boston, Mass. (John Waring, Manager)

Waring, R. S., Inventor of the Waring Anti, Induction Cables, 61, Westinghouse-bldg, Pittsburg, Pa.

Washburn and Moen Manufacturing Company, Wire Manufacturers and Wire Drawers, Worcester, Mass.; and at New York, &c.

Washington Electric Company, Makers of the "Washington" Arc Lamp, 197 and 199, South Canal-st, Chicago, Ill.

Wason, Chas. W., Electrical Engineer and Purchasing Agent, Cleveland Electric Railway Company, Cleveland, O.

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Waterhouse, Adison G., Electrical Engineer and Expert, Hartford, Conn.

Waterhouse, Frank G., Electrical Engineer, 302, Asylum-st, Hartford, Conn.

Waterhouse, Gamble & Co, Electricians, Makers of the Waterhouse Arc and Incandescent Lamps, 302, Asylum-st., Hartford, Conn.

Watts, H. Franklin, Electrical Engineer, 121, Liberty-st, New York

Weaver, Norman R.,, Electrician, Galveston, Texas

*Webb, Herbert Laws., Electrician, Metropolitan Telephone and Telegraph Company, 18, Cortlandt-st, New York

Webster, Dr. Arthur G., Assistant-Professor and Acting Director of the Physical Department, Clark University, Worcester, Mass.

Webster, Edwin S., Electrical Engineer, Manager Massachusetts Electrical Engineering Company, 4, Post Office-sq., Boston, Mass.

Weeks, Edwin R., General Manager Kansas City Electric Light Company, 301-303, National Bank of Kansas City-bldg, Kansas City, Mo. (*3593*)

Weems Electric Railway Company, Constructors of the Weems System of Electric Railways, Potter-bldg, New York, and Baltimore, Md.

Weems, D. G., Consulting Electrical Engineer and Inventor of the Weems Electric Railway System, Baltimore, Md.

Weller, Harry W., Electrical Engineer, Manager of the United Columbian Electric Company, 280, Broadway, New York; and Camden, N.J.

Wells, G. A., jun., Electrical Engineer, c/o C. and-C. Electric Company (Incorporated) 143, Liberty-st, New York

Welsh, Joseph F., Electrical Engineer, 833, Capitol-st, Philadelphia, Pa.

Welter, J. J., Electrical Engineer, 224, Dinwiddie-st, Pittsburgh, Pa.

Wemple's (W. B.) Sons, Manufacturers of the "Lesner" Turbine Water-Wheel, Fultonville, N.Y.

Wenstrom Consolidated Dynamo and Motor Company, Makers of Dynamos and Motors, Kemble-bldg, New York. (Benjamin Blum, General Manager)

Wenstrom Electric Manufacturing Company, Manufacturers of Electrical Apparatus, Baltimore, and Calverton, Md. (G. M. Hutton, President)

Werline Manufacturing Company, Limited, Manufacturers of Electrical and Mechanical Specialities, Clark-avenue, York, Pa.

Werner & Wood, Electrical Apparatus Makers, 18-30, West Randolph-st, Chicago, Ill.

West Coast Telephone Company, 13, Galeria San Carlos, Santiago, Chili. (*Electrode Santiago, &c.*)

Western Electric Company, Makers of Telephone, Telegraph and Electric Light Apparatus, 227, South Clinton-st, Chicago, Ill.; and corner of Greenwich and Thames-sts, New York. (*Electric Chicago; Microphone New York.*) (*See also* BRITISH DIVISION.)

Western Electric Construction Company, Electrical Engineers, 125, W. Sixth st, Kansas City, Mo.

Western Electric Heating Company, Manufacturers of Electric Heating Apparatus. 851-855, The Rookery, Chicago, Ill. (Geo. Cutter, Manager)

Western Electrician (weekly), 6, Lakeside-bldg, Chicago. (Ann. sub., U.S., $3; Postal Union, $5=£1 1s.)

Western Telephone Construction Company, Telephone Engineers and Contractors, 440, Monadnock-bldg, Chicago, Ill.

WESTERN UNION TELEGRAPH COMPANY. Head Office: 195, Broadway, New York. (Thos. T. Eckert, President) (*See also* BRITISH DIVISION.) **See Advt., p. cxxx.**

Westinghouse, Church, Kerr & Co, Contracting and Consulting Engineers, 17, Cortlandt-st, New York

Westinghouse Electric and Manufacturing Company, Manufacturers of the Westinghouse Systems of Electric Lighting, Pittsburg, Pa.; and at New York, Chicago, Ill., &c. (*See also* BRITISH DIVISION)

Westinghouse, Geo., jun, Consulting Electrician and Inventor, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

Weston, Edward, Electrician and Inventor, 120, William-st, and 645, High-st, Newark, N.J.

Weston Electrical Instrument Company, Manufacturers of Ammeters, Voltmeters, and other fine Electrical Measuring Instruments, &c. Office and Factory, 114 to 120, William-st, Newark, N.J. (*Weston Newark*)

Weston Engine Company, Makers of the Weston High Speed Engine, Painted Post, N.Y.

Weston (Wm. H.) & Co, Manufacturing Electricians, 830, Filbert-st, Philadelphia, Pa.

*Wetzler, Joseph, Editor of the *Electrical Engineer*, Mail and Express-bldg, 203, Broadway, New York. (President of the New York Electrical Society.) (*Longacre New York, 3860 Cortlandt*)

Whalen (John B.) & Co, Manufacturers of Electrical Supplies, Sycamore, Ill.

Wharton, (Wm., jun.) & Co, Manufacturers of Electrical Supplies, Philadelphia, Pa.

*Wheeler, Schuyler S., Sc.D. (President Crocker-Wheeler Electric Company), 39, Cortlandt-st, New York; and Ampère, East Orange, N.J.; and Electrical Expert to the Board of Electrical Control, 1265, Broadway, New York

Wheelock Engine Company, Makers of the Improved Wheelock Steam Engine, Worcester, Mass.

Wheless Underground Electric Company (Owners and Operators of the Wheless Conduit System), Mason-block, Tacoma, Wash.

Whitcomb, A W., Manufacturer of the Whitcomb Automatic Motors and Dynamos, 125, Gold-st, Worcester, Mass.

White House Mills, Electrical Apparatus Makers, Hoosick, N.Y.

White (J. G.) & Co, Electrical Engineers and Contractors, 29, Broadway, New York

White (R. J.) Manufacturing Company, Dealers in Electrical Supplies, 40-42, State-st, Chicago, Ill.

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White & Middleton Gas Engine Company, Makers of the "White-Middleton" Gas Engine, Baltimore, Md.

White, W. F., Electrical Engineer, 3012, Sherman-avenue, Omaha, Neb.

White (S. S.) Dental Manufacturing Company, Manufacturers of Electrical Dental Appliances, &c., Philadelphia, Pa.

Whitemore Manufacturing Company, Manufacturers of Electric Motors, Scranton, Pa.

Whitmore & Robinson, Consulting Electrical Engineers, 133, Essex-st, Boston, Mass.

Whitney Electrical Instrument Company, Electrical Instrument Makers Penacook, N.H.; and 146, Franklin-st, Boston, Mass.

Wilcox, L. M., Manufacturing Electrician, 219, Market-st, Newark, N.J.

Wildt, E. A., Maker of Electric Door Openers, 29 and 31, Sixth-st, Long Island City, N.Y.

Wilkes, Gilbert, Consulting Electrical Engineer, 149, Griswold-st, Detroit, Mich.

Wilkinson & Tinkham, Electrical Apparatus Makers, 24, Beach-st, Boston, Mass.

Williams Engine Works, Makers of Williams Automatic Engine, 62, Manufacturers Record-bldg, Baltimore, Md.

Williamson & Schroeder, Manufacturers of Electric Light Fittings, 205, Randolph-st, Chicago, Ill.

Willyoung, Elmer G., Electrician and Electrical Engineer, Queen & Co (Incorporated), 817, Filbert-st, Philadelphia, Pa.

Wilson, Fremont, Consulting and Contracting Electrical Engineer, 1111 Vanderbilt-bldg, 132, Nassau-st, New York

Wilson & Wilson, Electrical Engineers and Steam Engine Builders, North Tonawanda, Niagara County, N.Y.

Wilson & Jackson, Manufacturers of Electrical Apparatus, Times-bldg, Chicago, Ill. (*140*)

Winchester, A. E., Designer of Steam Electrical Plants, Wilton, Conn.

Wing (L. J.) & Co, Electrical Engineers, 126, Liberty-st, New York

Wing, Frank A., Consulting Electrician and Battery Expert, West Somerville, Mass.

Wintringham, J. P., Electrical Theorist, 36, Pine-st, New York. (*1222 Cortlandt*)

Wirsching (A.) & Sons, Makers of Arc and Incandescent Lamps, 28-32, Centre-st, New York.

Wirt, Charles, Electrical Engineer and Proprietor of the Wirt Laboratory, 56, Fifth-avenue, Chicago, Ill.

Wisconsin Electric Dynamo Company, Dynamo Manufacturers, Layton-pk, Milwaukee, Wis.

Wisconsin University, Madison, Wis.
Professor of Electrical Engineering ... ... } Dugald C. Jackson, B.S., C.E.
Professor of Electricity, Magnetism and Mathematical Physics ... } John E. Davies, M.A., M.D., LL.D.

Wolverton Glow Arc Electric Light Company, Glow-Arc Lamp Manufacturers, cor. Independence and Liberty-sts, New York

Wolcott, Townsend, Consulting Electrician, 177, Times-bldg, New York

Wolf (Aug.) & Co, Makers of the Wolf-Keiser Turbine Wheel, Chambersburg, Pa.

Wolfe Electrical Company, Electrical Engineers, 1614, Capital-avenue, Omaha, Neb.

Woodbridge & Turner Engineering Company, Electrical Engineers and Contractors, 47, Times-bldg, New York. (*1009 Cortlandt*)

*Woodbury, C. J. H., Consulting Electrician, Vice-President Boston Manufacturers' Mutual Fire Insurance Company, 31, Milk-st, Boston, Mass. (*928*)

WOODHOUSE & RAWSON UNITED, Ltd. Electrical Engineers and Contractors, 36, Wall-st, New York. **See Advt., p. 55** (*See also* BRITISH DIVISION)

Woodman, Durand, Ph.D., Analytical and Electro-Technical Chemist, 80, Beaver-st, and 127, Pearl-st, New York

Woods (G. T.) Manufacturing Company, Manufacturers of Electrical and Mechanical Appliances, &c., 138, Liberty-st, New York

Woodward Electrical Company, Electrical Engineers and Contractors, 69, Griswold-st, Detroit, Mich.

Woodward, Francke L., Electrician, 13, Kirkland-place, Cambridge, Mass.

Woolf Electrical Company, Electrical Engineers, 104, Washington-st, and 864, Lexington-avenue, New York

Woonsocket Electric Machine and Power Co, Electrical Apparatus Makers, Woonsocket, R.I.

Wreaks, Hugh T., Consulting Electrical Engineer, 1217, Filbert-st, Philadelphia, Pa.

Wright, Peter, Inspector of Electrical Works, United Gas Improvement Company, C. Drexel-bldg, Philadelphia, Pa. (*1390*)

Wright and Lindsey, Electric Traction Engineers, 29, Cone-st, Orange, N.J.

Wright Electrical Engineering Company, Electrical Engineers and Contractors, 196, Summer-st, Boston, Mass.

Wright & Starr Electric Company, Contracting and Consulting Electrical Engineers, 501, Girard-bldg, Philadelphia, Pa.

Wurts, Alexander Jay, Electrical Expert, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

— Y —

Yearsley-Harris Electric Company, Manufacturer of Electrical Machinery, Second-st and Ledger Place, Philadelphia, Pa.

York Manufacturing Company, Turbine Makers, York, Pa.

Young, C. G., Electrical Engineer, J. G. White & Co, 29, Broadway, New York, and 425, Maryland Ave, Baltimore, Md.

— Z —

Zaldarriaga, Hector, Electrical Engineer, 1056, Calle Victoria, Buenos, Ayres

Ziegler Bros, Manufacturers of Electrical Apparatus, 73, Federal-st, Boston, Mass.

Zimdars & Hunt, Manufacturing Electricians, 127, Fifth-avenue, New York

Zimmerman, Wm., Patent Agent and Electrical Expert, 164, Dearborn-st, Chicago, Ill.

Zucker & Levett Chemical Company, Motor, and Dynamo Manufacturers, 10, 12 and 14-Grand-st, New York

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The Officials of Electrical Companies, where obtainable, are set out in the ALPHABETICAL SECTION.

AGENTS, MANUFACTURERS'.

Askew & Russell, P.O. Box, 326, Chicago, Ill.
DIAGO, FREDERIC C., 30, Oficios-st, P.O. Box 278, Havana, Cuba. **See Advt., p. 496**
Nery da Fonseca, L., P.O. Box, 202, and 60, Rua Marquez de Olinda, Pernambuco
SHAIN, CHAS. D., 136, Liberty-st, New York

AMERICAN MACHINERY AGENTS.

DIAGO, FREDERIC C., 30, Oficios-st, P.O. Box, 278, Havana, Cuba. **See Advt., p. 496**

AMMETERS, MAKERS OF.

Brush Electric Company, Belden-st, Cleveland, O.
Electro-Dynamic Company, 224, Chestnut-st, Philadelphia, Pa.
General Electric Company, 620, Atlantic-avenue, Boston, Mass.; and Broad-st, New York
Queen & Co. (Incorporated), 924, Chestnut-st, Philadelphia, Pa.
Walker—Vail, W. A., 136, Liberty-st, New York
Weston Electrical Instrument Co, 114-120, Williams-st, Newark, N.J.
White House Mills, Hoosick, N.Y.

ARC LAMPS, MAKERS OF.

Acme—Schefbauer & Co, 28 and 32, Centre-st, New York
American—New American Electrical Arc Light Company, 2, Cortlandt-st, New York
Atwood—Atwood (A. H.) Electric and Manufacturing Company, 166-174, S. Clinton-st, Chicago, Ill.; and St. Louis, Mo.
Baby—Russell Electric Lamp Company, Portland, Me.
Ball—Ball Electric Light Company, 404, West Twenty-seventh-st, New York
Band—Siemens & Halske Electric Company, Monadnock-bldg, Chicago, Ill.
Brush—Brush Electric Company, Belden-st, near Mason-st, Cleveland, Ohio
Clark—Clark Electric Company, Corbin-bldg, 192, Broadway, New York
Cohen—National Electric Light and Power Company, Bullitt-bldg, Philadelphia, Pa.
Cowling—Powellton Electric Company, 108, S. 40th-st, Philadelphia, Pa.
Duplex—Duplex Electric Company, Limited, Corry, Pa.
Easton—Easton Electric Company, 643, Kent-avenue, Brooklyn, N.Y.
Excelsior—Excelsior Electric Company, 44, Broad-st, New York; and 425, The Rookery, Chicago, Ill.
General Incandescent Arc Lamp Company, 572-576, First-avenue, New York
Graves—Graves (W. D.) Electrical and Machine Works, Cleveland, O.

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Hawkeye Electric Manufacturing Company, Davenport, Iowa.
Helios—Helios Electric Company, 1305-1310, Filbert-st, Philadelphia, Pa.
Heymann—Consolidated Electric Manufacturing Company, 154, Franklin-st, Boston, Mass.
Howard—Royal Electric Company, Peoria, Ill.
Hunter—General Electric Company, 620, Atlantic-ave, Boston, Mass.; and Edison-bldg, New York.
Jenney—Fort Wayne Electric Company, Fort Wayne, Indiana
Klees—Klees, W. H., Susquehanna, Pa.
Knowles—General Electric Company, 620, Atlantic-avenue, Boston, Mass.; and Edison-bldg, New York
———Schuyler Electric Company, Middletown, Conn.
Krueger—Western Electric Company, 227, S. Clinton-st, Chicago, Ill.; and New York
Loomis—Eureka Electric Company, 18, Broadway, New York
Mason—Excelsior Electric Company, 44, Broad-st, New York; and at Chicago, Ill.
McLaughlin, James, 48-52, N. Clinton-st Chicago, Ill.
Milwaukee General Construction Company, 753, Monadnock-bldg, Chicago, Ill.
Mon-Arc—Little (F. P.) Electric Construction and Supply Company, 135, E. Seneca-st, Buffalo, N.Y.
Monitor—Western Electric Company, 227, South Clinton-st, Chicago, Ill.
Mosher—Mosher Electric Company, 125-127, Ontario-st, Chicago, Ill.
New Kester—Little (F. P.) Electric Construction and Supply Company, 135, E. Seneca-st, Buffalo, N.Y.
Nordlund—Nordlund Arc Lamp Company, Seattle, Wash.
Nutting—Nutting Electric Manufacturing Company, 128 and 130, South Clinton-st, Chicago, Ill.
Pennsylvania—Pennsylvania Electrical Engineering Company, Penn Mutual-bldg, Philadelphia, Pa.
Schuyler—Schuyler Electric Company, Middletown, Conn.
Scott Electrical Manufacturing Company, 89, Liberty-st, New York
Sperry—Sperry Electric Company, 195-207, Canal-st, Chicago, Ill.
Standard—Standard Electric Company, 625, Home Insurance-bldg, and 313-317, South Canal-st, Chicago, Ill.
Success—Dahl Electric Company, 120, Liberty-st, New York
Sun—Great Western Manufacturing Company, South Canal-st, Chicago, Ill.
Thomson-Houston—General Electric Company, 620, Atlantic-avenue, Boston, Mass.; and 44, Broad-st, New York
Turbayne—Turbayne-Tamblyn Company, 66-70, East Fort-st, Detroit, Mich.
Universal—Universal Arc Lamp Company, 42 and 44, Broad-st, New York
Van Depoele—General Electric Company, 620, Atlantic-av, Boston, Mass.; and New York
Wagniere—Wagniere Electric and Manufacturing Company, Los Angeles, Cal.
Ward—Electric Construction & Supply Company, 18, Cortlandt-st, New York; and Chicago, Ill.
Washington—Washington Electric Company, 197 and 199, South Canal-st, Chicago, Ill.
Waterhouse—Waterhouse, Gamble & Co, 302, Asylum-st, Hartford, Conn.
Western—Western Electric Company, 227, South Clinton-st, Chicago, Ill.; and New York
Westinghouse—Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.
Weston—United States Electric Lighting Company (Westinghouse Electric Company), 120, Broadway, New York
Wirsching (A.) & Sons, 28-32, Centre-st, New York

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Champion—Hirlimann, C. J., 117, Macdougal-st, New York
Chloride of Silver Dry Cell Battery Company, Baltimore, Md.
Crowdus—Electric Fare Box Company, 418, Cedar-st, Nashville, Tenn.
Diaphragm—Nowotny Electric Company, 30, East Fifth-st, Cincinnati, Ohio
Exeter—Greeley (E. S.) Company, 5 and 7, Dey-st, New York
Himmer & Anderson, 123, Chambers-st, New York
Imperial—Miamisburg Electric Company, Miamisburg, O.
Jupiter—Columbia Manufacturing and Supply Company, 340-342, Dearborn-st, Chicago, Ill.
Mesco—Manhattan Electrical Supply Company, 36, Cortland-st, New York
Meteor—Tod-Applegate Company, 340 and 342, Dearborn-st, Chicago, Ill.
Nassau—Nassau Electrical Company, 112, White-st, New York
Phonix—Western Electric Company, 227, S. Clinton-st, Chicago, Ill.
Standard—Bunnell (J. H.) and Company, 76, Cortlandt-st, New York

BATTERIES, GALVANIC, MAKERS OF.

Bryan, Marsh & Co, 136, Liberty-st, New York
McIntosh Battery and Optical Company, 141, Wabash-avenue, Chicago, Ill.
National Galvanic Battery Company, 13, Cortlandt-st, New York
Otto (F. G.) and Sons, 44-50, Sherman-avenue, Jersey City, N.J.
Perfect—Galvano-Faradic Manufacturing Company, 300, Fourth-avenue, New York

BATTERIES, PRIMARY, MAKERS OF.

Burnley—Miamisburg Electric Company, Miamisburg, O.
Cornell—Pheneger Chemical Company, Columbus, O.
Crescent—Ingersoll Sergeant Drill Company, 10, Park-place, New York
Electrical Fibre Carbon Company, 1223-1234, Michigan-avenue, Chicago, Ill.

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Franklin — Franklin Electric Company, 136, Liberty-st, New York
Fuller—Greeley (E. S.) Co, 5 and 7, Dey-st, New York
Gethins Gravity—Gethins Electrical Manufacturing Company, 620, Atlantic-avenue, Boston, Mass.
GONDA—**LECLANCHE BATTERY COMPANY**, 111-117, East 131st-st, New York. **See Advt., p. 448**
Hanson—Domestic Electric Power and Light Company, Baltimore, Md.
——— Falls City Electric Company, Louisville, Ky.
Hercules—Hercules Electric Company, 22, Custom House-place, Chicago, Ill.
High Rock—High Rock Battery and Novelty Company, 63, High Rock-st, Lynn, Mass.
Higgins Gravity Motor and Electric Gravity Clock Company, Chicago, Ill.
Hubbell—Consolidated Electric Motor Company, 77, Bedford-st, Boston, Mass.
Kolon—Marsh, C. D., 136, Liberty-st, New York
LECLANCHÉ (DISC and PRISM)—Leclanché Battery Company, 111-117, East 131st-st, New York **See Advt., p. 448**
Microphone Carbon—St. Louis Battery Manufacturing Company, 707, Locust-st, St. Louis, Mo.
Mystic Electric Motor Company, 120, Tremont-st, Boston, Mass.
New Atlantic—Electro-Chemical and Specialty Company, 136, Liberty-st New York
Pennock—Pennock Battery, Electric Light and Improvement Company, 334, Dearborn-st, Chicago, Ill
Perfect—Galvano Faradic Manufacturing Company, 300, 4th Avenue, New York
Salem Battery Company, Salem, Va.
Schwindt and Edelkamp, 610, Eighth-avenue, New York
Standard Gravity—Standard Battery Company, 334, Dearborn-st, Chicago, Ill.
Tilly and Van Hagen Company, 879, Gates-avenue, Brooklyn, New York
Tip—Kidder (Jerome) Manufacturing Company, 820, Broadway, New York
Turbayne—Turbayne-Tamblyn Company, 66-70, East Foot-st, Detroit, Mich.
Willoughby—Standard Battery Company, 334, Dearborn-st, Chicago, Ill.

BATTERIES, STORAGE, MAKERS OF.

Accumulator Company, 224, Chestnut-st., Philadelphia, Pa.
Accumulator and Motor Company, New Brighton, New York
Acme—Acme Storage Battery and Manufacturing Company, 29, Broadway, New York
American Standard Battery Company, 66½, Pine-st, New York
Bacon, Chas., Rock Hill, Conn.
Brush—Brush Electric Company, Belden-st, near Mason-st, Cleveland, Ohio
Bunnell (J. H.) & Co, 76, Cortlandt-st, New York
Bradbury-Stone Electric Storage Company, Lowell, Mass.
Chloride—Electric Storage Battery Company, Drexel-bldg., Philadelphia, Pa.
Coleman—Coleman Battery Company, Chicago, Ill.
Conqueror—Hero Electric Company, 78 and 80, Cortlandt-st, New York
Consolidated Electric Storage Company, 44, Broad-st, New York
Crescent—Minneapolis Electric and Construction Company, 27, South Fourth-st, Minneapolis, Minn.
Crowdus—Crowdus Chemical Electric Company, Memphis, Tenn.
Detroit—Woodward Electrical Company, 69, Griswold-st, Detroit, Mich.
Donaldson-Macrae Electric Company, 215, N. Calvert-st, Baltimore, Md.
Eaton, A. K., 46, Lexington-avenue, Brooklyn, N.Y.
Edco—Electro Dynamic Company, 224, Chesnut-st, Philadelphia, Pa.
Edison-Lalande—General Electric Company, 620, Atlantic-ave, Boston, Mass.; and Edison-bldg, New York.
Elastic—McRae, V. H., 87, Pulitzer-bldg, New York
Electric Power and Storage Company, Havemyer-bldg., New York; and Ashland, Wis.
Electric Road Carriage Company, 101, Milk-st, Boston, Mass.
Electrical Accumulator Company, 44, Broadway, New York; and Chicago, Ill.
Electrical Storage Battery Company, Allegheny-avenue, Philadelphia, Pa.
Ford-Washburn—Ford-Washburn Store-Electro Company, Cleveland, O.
Franklin — Franklin Electric Company, 136, Liberty-st, New York
1891—Foster, O. A., 8, Oliver-st. Boston, Mass.
Globe Storage Battery Company, Chicago, Ill.
Hero—Hero Electric Company, 78-80, Cortlandt-st, New York
Hussey Battery Company, 144, Greenwich-st, New York
Ideal—Bradbury-Stone Electric Storage Company, 1, 5 and 7, Grand-st, Lowell, Mass.
Johnson Storage Battery Company, 10, Mount Washington-st, Mass.
Knowles — General Electric Company, Boston, Mass.; and New York
Law—Law Battery Company, 85, John-st, New York
Lloyd & Paxton, Limited, 2, Wall-st, New York
Logan—Standard Electric Company, Detroit, Mich.
Loomis—Eureka Electric Company, 18, Broadway, New York.
Macracon—Macracon Storage Battery Company, 7, Wall-st, New York
Main—Union Electric Constructing Company, 312, North Eleventh-st, St. Louis, Mo.
Mason—Mason Electric Company, 10 and 12, Vandewater-st, New York
Molecular Storage Battery Company, 95, Milk-st, Boston, Mass.
Morris, H. G., Drexel-bldg, Philadelphia, Pa.
Morrison-Planté—American Battery Company, 188, Madison-st, Chicago, Ill.
National Storage Battery Company, Limited 626, Hammond-bldg, Detroit, Mich.
Neutral Storage Battery Company, Newark N.J.

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O'Keenan Electric Manufacturing Company, 45, Broadway, New York
Pacific Electrical Storage Company, 118-120, Pine-st, San Francisco, Cal.
Partrick & Carter Company, 125, South Second-st., Philadelphia, Pa.
Pumpelly-Sorley — Pumpelly-Sorley Storage Battery Company, 170, South Clinton-st, Chicago, Ill.
Rendrock Powder Company, 23, Park-place, New York.
Roberts—Roberts-Brevoort Electric Company, 208, Broadway, New York
Rowley—Clark & Marshall, 345, The Rookery, Chicago, Ill.
Samson—Electric Gas Lighting Company, 195, Devonshire-st, Boston, Mass.
Schuyler—Schuyler Electric Company, Middletown, Conn.
Silvey—Dayton Manufacturing Company, Dayton, O.
Smyth, C. A., Front and Locust-streets, Momence, Ill.
Sorley—Eastern Electric Light and Storage Battery Company, 37, Market-st, Box 406, Lowell, Mass.
Standard Electric Company, Detroit, Mich.
Syracuse—Syracuse Storage Battery Company, Syracuse, N.Y.
Taylor—Taylor Battery Company, 51, Dey-st, New York
Union Electric Company, 45, Broadway, New York; and Orangeburgh, N.J.
Union—Union Electric Co, 45, Broadway, New York
Usher—Hopedale Electric Company, Boston, Mass.
Vail, W. A., 126, Liberty-st, New York
Waddell-Entz — Waddell-Entz Company, 203, Broadway, New York
Western—Western Electric Company, 227, South Clinton-st, Chicago, Ill., and New York
Woodward Tubular — International Storage Battery Company, Detroit, Mich.

CABLES, SUBMARINE (*see* Electric Cable Makers).

CARBON MAKERS AND DEALERS.

Boulton Carbon Manufacturing Company, North Tonawanda, N.Y.
Brush Electric Company, Belden-st, near Mason-st, Cleveland, Ohio
Crouse-Tremaine Carbon Company, Fostoria, O.
Globe Carbon Company, Ravenna, Ohio
National Carbon Company, 40, Willson-avenue, Cleveland, Ohio
New York Carbon Works, 18, Cortlandt-st, New York
Solar Carbon and Manufacturing Company, 95, Fifth Avenue, Pittsburgh, Pa.

CENTRAL STATION VOLT- AND AMMETER MAKERS.

Weston Electrical Instrument Company, 114 to 120, William-st, Newark, N.J.

CENTRAL STATIONS, CONTRACTORS FOR THE CONSTRUCTION AND MAINTENANCE OF.

Brush Electric Company, Belden-st, Cleveland, Ohio
Fort Wayne Electric Company, Fort Wayne, Ind.
General Electric Company, 620, Atlantic-avenue, Boston, Mass.; and Broad-st, New York
Great Western Manufacturing Company, 195-207, S. Canal-st, Chicago, Ill.
Western Electric Company, 227, South Clinton-st, Chicago, Ill.
Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.

CONDUITS.

Brooks Underground Telegraph Construction Company, 307, Walnut-st, Philadelphia, Pa.
Builders Insulating Tube Company, 825, Washington st, Lynn, Mass.
Cummings & Engellman Conduit Company, Telephone-bldg, Detroit, Mich
Fibre Conduit Company, 45, Broadway, New York
Interior Conduit and Insulation Company, 42 and 44, Broad-st, New York

DYNAMO BRUSHES, MAKERS OF.

Wirt, Charles, 56, Fifth-avenue, Chicago, Ill. (Maker of the Wirt Dynamo Brush)

DYNAMOS, MAKERS OF.

Adams—Commercial Electric Company, 113, South Tennessee-st, Indianapolis, Ind.
Adams Electric Company, 100, Beacon-st, Worcester, Mass.
Akron—Akron Electrical Manufacturing Company, Akron, O.
American—New American Electrical Arc Light Company, 2, Cortlandt-st, New York
American Motor and Dynamo Company, Denver, Colo.
Arnold Electric Co., Chester, Pa.
Astoria Electrical Manufacturing Company, 14, Dey-st, New York. Factory: Astoria, N.Y.
Aurora—Aurora Electric Company, 2218 to 2220, Emerald-st, Philadelphia, Pa.
Averill—Onondaga Dynamo Company, 225-229, Walton-st, Syracuse, N.Y.
Ball—Ball Electric Light Company, 404, W. Twenty-seventh-st, New York
Bowers, Geo. E., 527, Main-st, Fitchburg, Mass.
Brush—Brush Electric Company, Belden-st, near Mason-st, Cleveland, Ohio
C. and C.—C. & C. Electric Company, (Incorporated) 143, Liberty-st, New York
C.P.—Easton Electric Company, 643, Kent-av, Brooklyn, N.Y.
Card—Card Electric Motor and Dynamo Company, Cincinnati, Ohio
Carpenter Electric Company, 116-118, Franklin-st, Chicago, Ill.
Clark—Clark Electric Company, 192, Broadway, New York
Cohen—National Electric Light and Power Company, Bullitt-bldg, Philadelphia, Pa.

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Colburn—Colburn Electric Manufacturing Co, 170, Main-st, Fitchburg, Mass.
Columbia—Columbia Electric Company, St. Paul, Minn.
Commercial—Commercial Electric Company, 113, South Tennessee-st, Indianapolis, Ind.
Compound Electric Motor and Dynamo Company, Chicago, Ill.
Consolidated Electric Manufacturing Company, 154, Franklin-st, and 155 and (Factory) 355, Congress-st, Boston, Mass.
Continental—Continental Dynamo Company, 63, Broadway New York
Crocker-Wheeler — Crocker-Wheeler Electric Company, Taylor-bldg, 39 & 41, Cortlandt-st, New York
Crown—Courter, Albert C., 209, Market-st, Newark, N.T.
Cushman—Granite State Electric and Machine Company, 36, South Main-st, Concord, N.H.
D. and D.—D. & D. Electric Manufacturing Company, Minneapolis, Minn.
Denison—Denison Electrical Manufacturing Co, 67, Orange-st, New Haven, Conn.
Detroit Motor Company, 1343-1355, Cass-avenue, Detroit, Mich.
Diamond Match Company, 41, Whitney-av, New Haven, Conn.
Dorman Dynamo Company, Chicago, Ill.
Edco—Electro-Dynamic Company, 224, Chesnut-st, Philadelphia, Pa.
Eddy—Eddy Electric Manufacturing Company, Windsor, Conn.; and New York
Edison—General Electric Company, Boston, Mass.; and Edison-bldg, New York
Eggers, F. F., 618, Merchant-st, San Francisco, Cal.
Eickemeyer—Bunnell (J. H.) & Co, 76, Cortlandt-st, New York
Elbridge—Elbridge Electrical and Manufacturing Company, Elbridge, N.Y.
Elliott—Elliott-Lincoln Electric Company, 78-80, East Prospect-st, Cleveland, O.
Eureka—Eureka Electric Company, 18, Broadway, New York
Excelsior—Excelsior Electric Company, 44, Broad-st, New York; and 425, The Rookery, Chicago, Ill.
———Rose Electric Light Supply Company, 1106, Pine-st, St. Louis, Mo.
FISH (H. C.) MACHINE WORKS, 152, Union st, Worcester, Mass.
Ford-Washburn—Ford-Washburn Store-Electro Company, Cleveland, O.
Fuller—Fontaine Crossing Company, Detroit, Mich.
Giant—Zucker and Levett Chemical Company, 10-14, Grand-st, New York
———Giant Electric Motor Company, Portland, Me.
Gray's Dynamo and Electric Machine Company, 15, Chardon-st, Boston, Mass.
Hanson and Van Winkle—Hanson and Van Winkle Company, 81, Liberty-st, New York
Hawkeye—Hawkeye Electric Manufacturing Company, Davenport, Iowa
Heisler—Heisler Electric Light Company, Drexel-bldg, Philadelphia, Pa.
Hill—Hill (W. S.) Electric Company, 133, Oliver-st, Boston, Mass.
Holtzer-Cabot—Holtzer-Cabot Electric Company, 92, Franklin-st, Boston, Mass.
Ironsides—Edgerton, N. H., 609, Commercial-st, Philadelphia, Pa.
Jackson—Hecla Electric Light Company, 26½, East Forty-second-st, New York
Jenney—Fort Wayne Electric Company, Fort Wayne, Indiana.
———Jenney Electric Motor Company, 224, South Illinois-st, Indianapolis, Ind.
———Jenney Star Electric Company, 176. Summer-st, Boston, Mass.
Keith—Electrical Engineering Company, 714. Jones-st, San Francisco, Cal.
Keller—Canton Electrical Company, 28, Cedar-st, Canton, O.
Kester—Kester Electric Company, 173, S. Canal st, Chicago, Ill.; and Terre Haute, Ind.
Keystone — Keystone Electric Company, cor. 14th and State-sts. Erie, Pa.
King—Detroit Dynamo Company, Detroit, Mich.
La Roche—La Roche Electrical Works, American and Diamond-sts, Philadelphia, Pa.
Little Wonder—Hanson & Van Winkle Co, 81, Liberty-st, New York: and Newark, N.J.
Loomis—Eureka Electric Company, 18, Broadway, New York
McLain (J. H.) Machine Company, Canton, O.
Mather—Mather Electric Company, Manchester, Conn.
Mayo—Rockford Electric Manufacturing Company, Rockford, and, The Rookery, Chicago, Ill.
Muncie—Muncie Electrical Works, Muncie, Ind.
Ney, R. W., Mechanic-st, Hartford, Conn.
New Century—New Century Electric Company, 21-25, Bethune-st, New York
Niagara—Lovell Manufacturing Company, Ltd, Erie, Pa.
Offrell—Schuyler Electric Company, Middletown, Conn.
Packard—New York and Ohio Company, Warren, O.
Palmer Bros, Mianus, Conn.
Patten—Patten Motor Manufacturing Company, 45, Lakeside-bldg, Chicago, Ill.
Perfect—Bernard (E. G.) & Co, Troy, N.Y.
Perret — Elektron Manufacturing Company, Springfield, Mass.
Pyle — Rockwood Manufacturing Company Indianapolis, Ind.
Quaker City Electric Company, 729, Winfield-pl, Philadelphia, Pa.
Queen City (Incandescent)—Queen City Electric Company, Cincinnati, Ohio
Rhodes Manufacturing Co, 918-922, Vine-st, Philadelphia, Pa.
Richter Electric Company, Camden, N.J.
Rockford—Rockford Electric Manufacturing Company, Rockford, and the Rookery, Chicago, Ill.
Royal Columbian—Royal Columbian Electric Company, 53, Dearborn st, Chicago, and Peoria, Ill.
Russell—Russell, Charles, 18, S. Broad-st, Philadelphia, Pa.
Sawyer-Man—Sawyer-Man Electric Company, 620, Atlantic-avenue, Boston, Mass.
Schaefer—Schaefer Electric Manufacturing Company, Boston and Cambridgeport, Mass.

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Schuyler—Schuyler Electric Company, Middletown, Conn.
Scribner—Western Electric Company, 227, South Clinton-st, Chicago, Ill.; and New York
Shawhan-Thresher—Shawhan-Thresher Electric Company, Dayton, O.
Short—Short Electric Railway Company, Cleveland, O.
Simpson—Simpson Electric Manufacturing Company, 39, West Washington-st, Chicago, Ill.
Slattery (Alternating)—Fort Wayne Electric Company, Fort Wayne, Ind.; and New York.
Sperry—Sperry Electric Company, 195-207, Canal-st, Chicago, Ill.
Standard—Standard Electric Company, 625, Home Insurance bldg, and 313-317 South Canal-st, Chicago, Ill.
Sutton-Steele Electric Manufacturing Company, Dallas, Texas
Tesla—Tesla Electric Light Manufacturing Company, Rahway, N.J.
Thomson-Houston—General Electric Company, 620, Atlantic-avenue, Boston, and Lynn, Mass.; and Edison-bldg, New York.
United States—United States Electric Lighting Company, 120, Broadway, New York
Van Depoele—General Electric Company, 620, Atlantic-avenue, Boston, and Lynn, Mass.
Wachtel—Wachtel (Charles) Electrical Manufacturing Company, Newark, N.J.
Waddell-Entz Company, 203, Broadway, New York; and Bridgeport, Conn.
Waterhouse—Waterhouse, Gamble & Co., 302, Asylum-st, Hartford, Conn.
Wenstrom—Wenstrom Electric Manufacturing Company, Baltimore, and Calverton, Md.
Western—Western Electric Company, 227, South Clinton-st, Chicago, Ill., and New York
Westinghouse—Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.
Weston—United States Electric Lighting Company, 120, Broadway, New York
Whitcomb—Whitcomb, A. W., Worcester, Mass.
Winkler—Troy Electric Dynamo Company, 553, River-st, Troy, N.Y.
Wisconsin Electric Dynamo Company, Layton Park, Milwaukee, Wis.
Wood American Electric and Manufacturing Company, Washington, D.C.
———Fort Wayne Electric Company, Fort Wayne, Ind.

ELECTRIC CABLE MAKERS.

Bishop Gutta Percha Company, 420-426, East 25th-st, New York
Brixey, W. R., 203, Broadway, New York.
Eastern Electric Cable Company, 61-65, Hampshire-st, Boston, Mass.
Moore, Alfred F., 200, N. 3rd-st, Philadelphia, Pa.
Okonite Company, Limited, 13, Park-row, New York. Works: Passaic, N.J.
Standard Underground Cable Company, Westinghouse-bldg, Pittsburgh, Pa.
Tatham & Bros, 226, South Fifth-st, Philadelphia, Pa.

ELECTRIC CRANES AND LIFTS, MAKERS OF.

Albro-Glem Elevator Company, Limited, 411-413, Cherry-st, Philadelphia, Pa.
Beckwith, N., 48, Beverley-st, Boston, Mass.
Central Machine and Foundry Co., Quincy, Ill.
Crane Elevator Company, Chicago, Ill.
Craven, (S. Norris) & Co, Limited, 515, Mulberry-st, Philadelphia, Pa.
Detroit Foundry Equipment Company, Detroit, Mich.
Fay (J. A.) and Egan Company, Cincinnatti, O.
Frisbie Elevator and Manufacturing Company, New Haven, Conn.
Graves Elevator Company, Rochester, N.Y.
Hale Elevator Company, 189, La Salle-st, Chicago, Ill.
Maris and Beckley, 2343-2345, Callowhill-st, Philadelphia, Pa.
Moore & Wyman, corner Granite and Richards-streets, South Boston, Mass.
Morse, Williams & Co, 105, Frankford-av, Philadelphia, Pa.
Nicholson Electric Hoist Company, 84, Champlain-st, Cleveland, Ohio
Otis Brothers & Co, 38, Park-row, New York
Richard Elevator Works, 1232, Ridge-av, Philadelphia, Pa.
Sellers (W.) & Co, Philadelphia, Pa.
Shaw Electric Crane Company, Muskegon, Mich.
Sprague Electric Elevator Company, Postal Telegraph-bldg, New York
Stokes & Parrish Elevator Company, Bullitt-bldg, Philadelphia, Pa.

ELECTRIC FANS.

Anderson & Johnson, 46-48, S. Canal-st, Chicago, Ill.
Barney Ventilating Fan Company, Pearl-st, Boston, Mass.
Bates (D. L.) and Co., Dayton, O.
Beers Electrical Fan and Motor Company, Newark, N.J.
Commonwealth Electric Company, 414, Market-st, Philadelphia, Pa.
Davidson Ventilating Fan Company, 137, Milk-st, Boston, Mass.
Diehl & Co, 385, Broadway, New York.
Gem City Manufacturing Company, Limited, Erie, Pa
Huyett and Smith Manufacturing Company, Detroit, Mich.
Rabich Fan and Motor Manufacturing Company, East St Louis, Mo.
Randolph, R. J., 425, The Rookery, Chicago, Ill.
Simpson Electric Manufacturing Company, 39, W. Washington-st, Chicago, Ill.
Standard—American Universal Electric Company, 26, Whitehall-st, New York
Standard Cyclone—Standard Electric Company, 2246-2248, N. Ninth-st, Philadelphia, Pa.
Sturtevant (B. F.) Company, Jamaica Plain, Boston, Mass.

ELECTRIC HEATING APPARATUS, MAKERS OF.

American Electric Heating Corporation, 274, Purchase-street, Boston, Mass.
American Electro-Enamelite Company 333, The Rookery, Chicago, Ill.

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Central Electric Heating Co., 617-620, Havemeyer-bldg, 26-28, Cortlandt-st, New York.
Dewey Electric Heating Company, 501-514, Kirk-bldg, Syracuse, Ny.
Entrekin-Elder Electric Company, Harrisburg, Pa.
Rich Electrical Heating Company, Mount Vernon, N.Y.
Toledo Electric Heating Company, Toledo, O.
Western Electric Heating Company, 851-855, The Rookery, Chicago, Ill.

ELECTRIC HOUSE WORK, CONTRACTORS FOR.

Ries Electric Specialty Company (Incorporated), 7, South Gay-st, Baltimore, Md.
Wing, Frank A., West Somerville, Mass.

ELECTRIC INSULATING MATERIALS FOR ALL PURPOSES.

H. W. JOHNS MANUFACTURING CO, 87, Maiden-lane, New York City, U.S.A.

ELECTRIC LAUNCH, &c., BUILDERS.

Electric Launch and Navigation Company, Camden, N.J.
General Electric Launch Company, 44, Broad-st, New York
Universal Electric Launch Company, 45, Broadway, New York

ELECTRIC LICHT ENGINEERS AND CONTRACTORS.

Aluminum Battery, Electric Light and Power Company, 78 and 80, Cortlandt-st, New York
Baker (C. H.) & Co, Seattle, Wash.
Ball Electric Light Company, 404, W. Twenty-Seventh-st, New York.
Brush Electric Company, Belden-st, near Mason-st, Cleveland, Ohio
California Electrical Works, 35, Market-st, San Francisco, Cal.
Cataract General Electric Company, Mutual Life Insurance-bldg, New York
Compañia Anónima de Luz Electrica de Londres, Casilla 74, Rosario de Santa Fé, Argentine Republic
Compañia de Alumbrado Electrico, 14, Calle Yerbal, Monte Video
Compañia Nacional Luz Eléctrica, Calle Cerrito 108, Montevideo
Complete Electric Construction Company 121, Liberty-st, New York
Continental Electric Construction Company, 1,118, Chamber of Commerce-bldg, Chicago, Ill.
Cooke (Edward T.) Electric Company, 1408, Chestnut-st, St. Louis, Mo.
Cornell Electrical Engineering Company, 45, Broadway, New York
DIAGO, FREDERIC C., 30, Oficios-st, P.O. Box 278, Havana, Cuba. **See Advt.**, p. 496
Electric Construction and Supply Company, 18, Cortlandt-st, New York
Electrical Construction Company, 43 & 45, Franklin-st, Chicago, Ill.
Electro-Dynamic Company, 224, Chestnut-st, Philadelphia, Pa.
Empreza Luz Electrica Cassels, Central Station, Barraccas al Sud, Buenos Ayres
Excelsior Electric Company, 44, Broad-st, New York; and 425, The Rookery, Chicago, Ill.
Fleming (W. R.) & Co, 203, Broadway, New York
General Electric Company, 620, Atlantic-ave, Boston, Mass.; and Broad-st, New York, &c.
Gordon (W. H.) & Co, 115, Broadway, New York
Griffith (W. S.) & Co, 114, South Fifteenth-st, Philadelphia, Pa.
Hathaway (A. G.) & Robinson, Cleveland, O.
Hecla Electric Light Company, 26½, East Forty-Second-st, New York
Kingsbury & Mustard, Baltimore, Md.
Lima Electric Company, Lima, Peru
Maine Electric Improvement Company, Brunswick, Me.; and Electrical Exchange-bldg, New York
Metropolitan Electrical Corporation, 415-417, Whitney-bldg, Kansas City, Mo.
Metropolitan Electric Service Co, 575, Madison-avenue, and 120, Broadway, New York
Minneapolis Electric and Construction Company, 27, South Fourth-st, Minneapolis, Minn.
Muckle (M. R., jun.) & Co, 210, Drexel-bldg, Philadelphia, Pa.
Murray (Thomas) Company, 136, Liberty-st, New York
New American Electrical Arc Light Company, 2, Cortlandt-st, and 163-165 West Eighteenth-st, New York
New Central Electric Company, Minneapolis, Minn.
New York Electrical Engineering Company, 45, Broadway, New York
North-West Electric Manufacturing Company, Portland, Ore.
Putnam (J. E.) & Co, 10, Tallman-bldg, 27, East Main-st, Rochester, N.Y.
Ries Electric Speciality Company (Incorporated), 7, South Gay-st, Baltimore, Md.
River Plate Electricity Company, Limited, 858, Calle Cangallo, Buenos Ayres; and at La Plata and Rosario
Sawyer-Man Electric Company, 620, Atlantic-avenue, Boston, Mass.
Seafert (Wm.) & Co, 159 and 161, La Salle-st, Chicago, Ill.
Standard Electric Equipment Company, 67 Grand-st, New York
Talcott, Wm. M., 6-10, Pacific-avenue, Chicago, Ill.
Tesla Electric Light Manufacturing Company, Rahway, N.J.
Tucker Electrical Construction Company, 14-20, Whitehall-st, New York
Tucker & Hall, 432-434, Electrical Exchange-bldg, New York
Union Electric Construction Company, 312, North Eleventh-st, St. Louis, Mo.
United Gas Improvement Company, Drexel-bldg, Philadelphia, Pa.
United States Electric Lighting Company, 120, Broadway, New York
Volta Eclipse Electrical Manufacturing and Supply Company, 230, Main-st, Memphis, Tenn.
Western Electric Construction Company, 125, W. Sixth-st, Kansas City, Mo.
Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.

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Wilson & Wilson, North Tonawanda, Niagara County, N.Y.
Woodbridge & Turner Engineering Company, 47, Times-bldg, New York
Woodward Electrical Company, 69, Griswold-st, Detroit, Mich.
Wright Electrical Engineering Company, 196, Summner-st, Boston, Mass.
Wright & Starr Electric Company, 501, Girard-bldg, Philadelphia, Pa.

ELECTRIC LIGHT FITTINGS MAKERS.

Buck (W. J.), Sons & Co, 415, N. 8th-st, Philadelphia, Pa.
Buckeye Electric Company, P.O. Box 123, Cleveland, O.
Central Gas and Electric Fixture Company, 224-232, Canal st, and 118-126, Walker-st, New York
Clark and Cowles, Plainville, Conn.
Edwards (W. S.) Manufacturing Co, 21 and 23, East Lake-st, Chicago, Ill.
General Electric Company, 620, Atlantic-avenue, Boston, and Broadway, New York
Glenny (W. H.), Sons & Co, 251-257, Main-st, Buffalo, N.Y.
Hatton (L. D.) & Co, cor. Greene and W. 4th-st, New York
Holman (F.) Electric Co, 128, Pearl-st, New York
Remhof, A., 375 381, Kent-ave, Brooklyn, N.Y.
RIES ELECTRIC SPECIALTY COMPANY (Incorporated , 7, South Gay-st, Baltimore, Md.
Simmons (John) Company, 308, Centre-st, New York
Star Electrix Company, Warner-bldg, 1308, Filbert-st, Philadelphia, Pa.
Vosburgh (W. C.) Manufacturing Company, Ltd, 269-281, State-st, Brooklyn, N.Y.
Williamson & Schroeder, 205, Randolph-st, Chicago, Ill.

ELECTRIC LIGHT SYSTEMS.

Ball Electric Light Company, 404, West Twenty-Seventh-st, and Ninth-avenue, New York
Brush Electric Company, Belden-st, Cleveland, O.
Clark Electric Company, Corbin-bldg, 192, Broadway, New York
Electro-Dynamic Company, 224, Chestnut-st, Philadelphia, Pa.
Elektron Manufacturing Company, Springfield, Mass.
Eureka Electric Company, 18, Broadway, New York
Excelsior Electric Company, 44, Broad-st, New York
Fort Wayne Electric Company, Fort Wayne, Ind.
General Electric Company, Edison-bldg, New York ; and Boston, Mass.
Hawkeye Electric Manfacturing Company, Davenport, Ia.
Mather Electric Company Manchester, Conn.
National Electric Light and Power Company, Bullitt-bldg, Philadelphia, Pa.
Sawyer-Man Electric Company, 510-534, West Twenty-third-st, New York
Schuyler Electric Company, Middletown, Conn.
Sperry Electric Company, 195-207, Canal-st, Chicago, Ill.
Standard Electric Company of Vermont, St. Johnsbury, Vt.
United States Electric Lighting Company, 120, Broadway, New York
Western Electric Company, 227, South Clinton-st, Chicago, Ill.
Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

ELECTRIC MOTORS, MAKERS OF.

American—Akron Electrical Manufacturing Company, Akron, O.
American Electric Motor Company, 115, Broadway, New York
Audubon Machine Works, 41, Whitney-avenue New Haven, Conn.
Automatic—Whitcomb, A. W., 125, Gold-st, Worcester, Mass.
Bain—Great Western Manufacturing Company, 195-207, South Canal-st, Chicago, Ill.
Baxter—Baxter Motor Company, Biddle, Chester and Chase-sts, Baltimore, Md.
Bernstein—Bernstein Electric Co., 620, Atlantic-ave, Boston, Mass.
Bijou—Consolidated Electric Motor Company, 77, Bedford-st, Boston, Mass.
Billberg—Dallett (Thos. H.) & Co., York-st and Sedgeley-ave, Philadelphia, Pa.
Bishop, W. S., 958, Grand-avenue, New Haven, Conn.
Bonnie-Breeze—Holtzer-Cabot Electric Company, 92, Franklin-st, Boston, Mass.
Boston Motor Company, 17, Batterymarch-st, Boston, Mass.
Brush Electric Company, Belden-st, near Mason-st, Cleveland, Ohio
Buckley Electric and Manufacturing Company, cor. Rose and Eleanor-streets, Kalamazoo, Mich.
"C and C"—"C and C" Electric Motor Company, Incorporated, 143, Liberty-st, New York
Card—Card Electric Motor and Dynamo Company, corner Broadway and Hunt-st, Cincinnati, Ohio
Chandler & Farquhar, 179, Washington-st, Boston, Mass.
Chicago—Chicago Electric Motor Company, 313, S. Canal-st, Chicago, Ill.
Cincinnati Electric Engine Company, 12, East Third-st, Cincinnati, Ohio
Clark—Clark Electric Company, 198, Broadway, New York
Cleveland Motor Company, 409, Broadway, New York, and at Chicago, Ill.
Cyclone—La Boiteaux Electric Motor and Fan Company, 376, Walnut-st, Cincinnati, O.
Columbia—Columbia Electric Company, 207, East Fourth-st, St. Paul, Minn.
Commercial—Commercial Electric Co, Indianapolis, Ind.
Connecticut—Connecticut Motor Company, Plantsville, Conn. ; and New York
Consolidated Electric Manufacturing Company, 154, Franklin-st, and 155 and 355, Congress-st, Boston, Mass.

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Crocker-Wheeler — Crocker-Wheeler Electric Company, 39-41, Cortlandt-st, New York
Dahl—Dahl Electric Company, 120, Liberty-st, st, New York
D.D.—D.D. Electric Motor Company, 327, St. Peter-st, St. Paul, Minn.
De Mott—De Mott Motor and Battery Company, 173, Greenwich-st, and 114, Liberty-st, New York
Denison—Denison Electrical Engineering Company, 65, Orange-st, New Haven, Conn.
Detroit—Detroit Motor Company, 1343-1355, Cass-ave, Detroit, Mich.
Dollar—Ingersol (Robert H.) & Bros, 65, Cortland-st, New York
Dresskell—Dresskell, Wm., Brainerd, Minn.
Du Charme Company, 96, Lake-st, Chicago, Ill.
Edco—Electro-Dynamic Co, 224, Chestnut-st, Philadelphia, Pa.
Eddy—Eddy Electric Manufacturing Company, Windsor, Conn.; and New York
Edison—General Electric Co, 620, Atlantic-avenue, Boston, Mass.; and Broad-st, New York
Eickemeyer—Bunnell (J. H.) & Co, 76, Cortland-st, New York
Emerson—Emerson Electric Manufacturing Co., 1110-1112, St. Charles-st, St. Louis, Mo.
Excelsior — Excelsior Electric Company, 44, Broad-st, New York
Feldkamp—Electrical Piano and Motor Company, Newark, N.J.
Ford and Washburn—Ford-Washburn Storelectro Company, Cleveland, O.
1891—Foster, O. A., 8, Oliver-st, Boston, Mass.
Giant—Giant Electric Motor Company, 27, School-st, Boston, Mass.
Hawkeye — Hawkeye Electric Manufacturing Company, Davenport, Ohio
Hercules—Zucker & Levett Chemical Company, 10-14, Grand-st, New York
Hero—Hero Electric Co., 78-80, Cortlandt-st, New York
Hill—Hill (W. S.) Electric Company, 133, Oliver-st, Boston, Mass.
Holtzer-Cabot—Holtzer-Cabot Electric Co., 92, Franklin-st, Boston, Mass.
Homer (F. E.) & Co, 46, S. Water-st, Cleveland, O.
Hyer-Sheehan — Hyer-Sheehan Electric Motor Company, Stafford-springs, Conn.; and Newburg, N.Y.
Ironsides—Edgerton, N. H., 609, Commercial-st, Philadelphia, Pa.
Jenney—Jenney Electric Motor Company, 224, South Illinois-st, Indianapolis, Ind.
Keith—Electrical Engineering Company, 714, Jones-st, San Francisco, Cal.
Kester—Kester Electric Company, 173, S. Canal-st, Chicago, Ill.; and Terre Haute, Ind.
Keystone—Keystone Electric Company, Erie, Pa.
La Roche—La Roche Electrical Works, American and Diamond-sts, Pittsburg, Pa.
Leavitt—Leavitt Mott Company, 124, Mitchell-st, Providence, R.I.
Little Jewel—Kennedy, John R., San Bernardino, Cal.
Loomis—Eureka Electric Company, 18, Broadway, New York
Lundell (Fan)—Interior Conduit and Insulation Co., 44, Broad-st, New York
Main – Union Electric Company, 47, Broadway, New York
Mason—Excelsior Electric Co., 44, Broad-st, New York
Mather—Mather Electric Co., Manchester, Conn.
Mayo—Rockford Electric Manufacturing Company, Rockford, Ill.; and Chicago, Ill.
Meston—Emerson Electric Manufacturing Company, St. Louis, Mo.
Muncie—Muncie Electrical Works, Muncie, Ind.
Niagara—Lovell Manufacturing Company, Limited, Erie, Pa.
Palmer—Palmer Bros, Mianus, Conn.
Paterson Electrical Manufacturing Company, Paterson, N.J.
Patten—Patten Motor Manufacturing Company, 45, Lakeside-bldg., Chicago, Ill.
Perret — Elektron Manufacturing Company, Springfield, Mass.
Porter—Porter Electric Motor Company, 62, World-bldg, New York
Premier—Premier Electric Company, 17 and 19, Whipple-st., Brooklyn, N.Y.
Quaker City—Quaker City Electric Company 729, Winfield-place, Philadelphia, Pa.
Rabich (Fan)—Rabich Fan and Motor Manufacturing Company, East St. Louis, Mo.
Ries and Scott—Ries Electric Specialty Company (Incorporated), 7, South Cay-st, Baltimore, Md.
Riker—Riker Electric Motor Company, 45-47, York-st, Brooklyn, N.Y.
Schuyler — Schuyler Electric Manufacturing Company, Middletown, Conn.
Short—Short Electric Railway Company, Cleveland, O.
Simplex—Simplex Electrical Company, 75-81, Cornhill, Boston, Mass.
Simpson (Fan)—Simpson Electric Manufacturing Company, 39-41, West Washintgon-st, Chicago, Ill.
Smith—Huyett and Smith Manufacturing Company, Detroit, Mich.
Sprague—General Electric Company, Boston, Mass.; and Edison-bldg, New York
Snow & Starkie, Hartford, Conn.
Stanley & Kelly—Stanley Electric Manufacturing Company, Pittsfield, Mass.
Storey—Hornell Iron Works, Hornellsville, N.Y.
——— Storey Motor and Tool Company, 120, Liberty-st, New York
Stow—Stow Manufacturing Company, Binghampton, N.Y.
Tesla—Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.
Thomson-Houston—General Electric Company 620, Atlantic-avenue, Boston, Mass.; and Broad-st, New York
Thone—Hawkeye Electric Manufacturing Company, Davenport, Iowa
United States—United States Electric Lighting Company, 120, Broadway, New York; and Newark, N.J.
Waddell-Entz—Waddell Entz Electric Company, 203, Broadway, New York
Wagner—Wagner Electric Manufacturing Company, St. Louis, Mo.
Walker Manufacturing Company, Cleveland, O.

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Wenstrom—Wenstrom Consolidated Dynamo and Motor Company, Kemble-bldg, New York
Westinghouse (Alternating)—Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.
Whitcomb—Whitcomb, A. W., 125, Gold-st, Worcester, Mass.
Zucker and Levett—Zucker and Levett Chemical Company, 10-14, Grand-st, New York

ELECTRIC TRACTION ENGINEERS.

DIAGO, FREDERIC C., 30, Oficios-st, Post Office Box 278, Havana, Cuba. **See Advt., p. 495**
General Electric Company, 620, Atlantic-avenue, Boston, Mass.; and Edison-bldg, New York
Harrington, Walter E., 307, Market-st, Camden, N.J.
Sperry Electric Railway Company, Cleveland, O.
Westinghouse Electric Railway Company, Pullman-bldg, Chicago, Ill.

ELECTRIC TRANSMISSION OF POWER.

Cataract General Electric Company, Mutual Life Insurance-bldg, New York
FISH (H. C.) MACHINE WORKS, 152, Union-st, Worcester, Mass.
General Electric Company, 620, Atlantic-avenue, Boston; and Broad-st, New York
Pacific Electrical Storage Company, 118-120, Pine-st, San Francisco, Cal.
Seafert (Wm.) & Co, 159 and 161, La Salle-st, Chicago, Ill.
Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.
Woodbridge & Turner Engineering Company, 47, Times-bldg, New York

ELECTRICAL AGENTS.

Cushing & Morse, 225, Dearborn-st, Chicago, Ill. (Day's Kerite)
DIAGO, FREDERIC C., 30, Oficios-st, P.O. Box 278, Havana, Cuba. **See Advt., p. 496**
Jannus, Frankland, Atlantic-bldg, 928-930, F-st, Washington, D.C.
Queen & Co (Incorporated), 924, Chestnut-st Philadelphia, Pa.
Royce & Marean, 1410, Pennsylvania-avenue, Washington, D.C.
Saavedra, Bénard y Ca, Casilla 556, Valparaiso, Chili
SHAIN, CHAS. D., 136, Liberty-st, New York (Agent for the Siemens & Halske Co. of America)
Sioux City Electrical Supply Co, Sioux City, Iowa

ELECTRICAL APPARATUS MAKERS.

Abatis Electric Manufacturing Company, 65, Lees-bldg, 149, Fifth-avenue, Chicago, Ill.
Abendroth and Root Manufacturing Company, 28, Cliff-st, New York
Allen-Maxwell Manufacturing Company, Chicago, Ill.
American Electric Company, 102, Pearl-st, Boston, Mass.
American Electrical Appliance Company, 39, Dey-st, New York
American Electrical Arc Light Company, 71, Broadway, New York; and at New Haven, Conn.
Andrews & Johnson, 46-48, South Canal-st, Chicago, Ill.
Anglo-American Electrical Manufacturing Company, 136, Liberty-st, New York
Anthony, E. & H. T., 591, Broadway, New York
Archer Electric Company, La Fayette, Ind.
Ashley Engineering Company, 136, Liberty-st, New York
Atlantic Electric Manufacturing Company, Brooklyn, N.Y.
Ayres, W. J., Caixa No. 1, Pernambuco
Barnes (W. F. & Jno.) Company, 357, Ruby-st, Rockford, Ill.
Beattie Zinc Works Company, Reading, Mass.
Beggs (John E.) Machinery and Supply Company, 74, Cortlandt-st, New York
Bergmann, S., 59, Duane-st, New York
Blakeney Electric Company, 431, Broadway, New York
Bliss (E.W.) Company, 17, Adams-st, Brooklyn, N.Y.
Blodgett Manufacturing Company, 1062, Ashland Block, Chicago, Ill.
Boston Electric Company, 548, Washington-st, Boston, Mass.
Bradley Manufacturing Company, Ashtabula, O.
Brady Manufacturing Company, 82, Washing-st, Brooklyn, N.Y.
Brooklyn Electric Manufacturing Company, 286-290, Graham-st, Brooklyn, N.Y.
Brown Electric Company, cor. Sumner and Federal-sts, Mass.
Brush Electric Company, Belden-st, near Mason-st, Cleveland, Ohio
Bryant Electric Company, Bridgeport, Conn.; and at Chicago, Ill.
Carpenter-Neven's Electric Heating Company, 106½, First Avenue, North Minneapolis, Minn.
Carpenter Electric Power and Light Company, East St. Louis, Ill.
Carroll Electric Company, Portland, Me.
Carter-Guy Electric Company, 125, Fifth-avenue, Pittsburg, Pa.
Central and Consolidated Electric Company, 68, Broad-st, Elizabeth, N.J.
Chadbourne, A. H., 509, Arch-st, Philadelphia, Pa.
Chicago Electrical Construction Company, Chicago, Ill.
Chicago Electrical Manufacturing Company, 73, W. Jackson-st, Chicago, Ill.
Clark (Ernest L.) Company, 331, The Rookery, Chicago, Ill.
Cleveland Electrical Manufacturing Company, 837, Sheriff-st, Cleveland, Ohio
Columbia Machine Works, 11-17, South Jefferson-st, Chicago, Ill.
Companhia Brazileira de Electricidad, 109-117, Rua Ouvidor, Rio de Janeiro
Crosby Electric Company, 110, Fifth-avenue, and 121, South Fifth-avenue, New York
Crown Electric Manufacturing Company, Bridgeport, Conn.; and 18, Cortland-st, New York
Dale Manufacturing Company, 22, Cortland-st, New York
Days & Co, 222, Sutter-st, San Francisco, Col.

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Delaware Electric and Supply Company, Wilmington, Del.
Dewey Manufacturing Company, Syracuse N.Y.
Doubleday, Mitchell & Company, 136, Liberty-st, New York
Durant, Walter N., 237, Twenty-second-st, Milwaukee, Wis.
Eagle Electric Manufacturing Company, Superior, Wis.
Eaton (G. H.) & Co, Boston, Mass.
Eimer & Amend, 205-211, Third-ave, Cor. 18th-st, New York
Electric Construction and Supply Company, 18, Cortlandt-st, New York
Electric Manufacturing Company, Troy, N. Y.
Electric Selector & Signal Company, 45, Broadway, New York
Electric Supply and Contracting Company, Nevada-bldg, Fifth and Sycamore-sts, Cincinnati, Ohio
Electrical Cutter Co, 166, Elm-st, New York
Electrical Manufacturing Company, 8-10, N. Jefferson-st, Dayton, O.
Electrical Manufacturing & Gas Engine Company, Havemeyer-bldg, New York
Electrical and Mechanical Engineering and Trading Company, 44, Broad-st, New York
Enamel Electric Manufacturing Company, E. Orange, N.J.
Esperson (A. F.) Company, P.O. Box 1106, Tacoma, Wash.
Euclid Avenue Electric Company, 1144, Euclid-avenue, Cleveland, O.
Facer (Wilson E.) & Co, 145, Bank-st, Cleveland, O.
Falconer Manufacturing Company, Hartford-st, Boston, Mass.
Francis, J. G., 100, Greenwich-st, New York
Gill (Alexander) Electric Manufacturing Company, Gibraltar-bldg, Kansas City, Mo.
Gleason (E. P.) Manufacturing Company, 181-189, Mercer-st, New York
Goodrich-Coleman Electrical Works, 31, South Canal-st, Chicago, Ill.
Graton & Knight Manufacturing Company, Worcester, Mass.
Graves (W. D.) Electrical and Machine Works, 8, Case-pl, and 6-12 Rockwell-st, Cleveland, O.
Greeley (E. S.) Company, 5 and 7, Dey-st, New York
Heath Electric Company, 324, Grand River-avenue, Detroit, Mich.
Heinze Electric Company, 658, Washington-st, Lynn, Mass.
Hewitt (F. A.) & Co, S. Water-st, Cleveland, O.
Hollings (R.) & Co, 525, Washington-st, Boston, Mass.
Hornberger Electric Manufacturing Company, Elkhart, Ind.
Hubley Manufacturing Company, Lancaster, Pa.
Hughes Bros. Manufacturing Company, Chattanooga, Tenn.
Humphreys Manufacturing Company, 33, South Canal-st, Chicago, Ill.
Hunger (C. F.) Company, Cleveland, O.
Independent Electric Company, 100, Washington-st, Chicago, Ill.
Interstate Complete Electric Construction Co 309-817, S. 7th-st, St. Louis, Mo.
Irish, W. E., 48-50, Long-st, Cleveland, Ohio
Isham, A. D., P. O. Box 171, Buffalo, N.Y.
Jackson & Sharp Company, Wilmington, Del.
Jones (F. P.) & Co, 255, Pearl-st, Buffalo, N.Y.
Jordan (L. J.) & Co, 133, Oliver-st, Boston, Mass.
Jost, Edmund, 350 and 352, Plane-st, Newark, N.J.
Kansas City Electrical Works, Kansas City, Mo
Kelly, I. W., 1,223, Filbert-st, Philadelphia, Pa.
King (H.) & Son, Corry, Pa.
Klein's (John M.) Electrical Works, 1007-1009, Alabama-st, San Francisco, Cal.
Krogh Manufacturing Company, San Francisco, Cal.
Lane Manufacturing Company, Kenosha, Wis.
McDougall & Cummings, Unity-bldg, Chicago, Ill.
Magneto-Electric Manufacturing Company, 518-522, West 35th-st, New York
Maine Electrical Construction Company, Fairfield, Me.
Manion & Co, New Orleans, La.
Marshall, Wm., 2 and 4, University-bldg, New York
Martins da Silva, Jose, 1, Travessa da Se, and 109, Rua do Brazil, Sao Paulo, Brazil
Marvin Electric Drill Company, Schenectady, N.Y.
Mason, J. H., 10-12, Vanderwater-st, Brooklyn, N.Y.
Matthews & Willard Manufacturing Company, 40, Murray-st, New York
Menominee Electric and Mechanical Company, Menominee, Mich.
Metropolitan Electric Company, 522 and 523, Monadnock-bld, Chicago, Ill.
Meyrowitz Bros., 295 and 297, Fourth-avenue, New York
Miamisburg Electric Company, Miamisburg, O.
Midland Electric Works, 108, Fifth-avenue, st, Chicago, Ill.
Miller Electric Company, 13, Astor-place, New York
Mitchell Electric Company, St. Paul, Minn.
Montana Electric Company, Butte, Montana
National Electric Brake Company, St. Louis, Mo.
National Electric Company, Eau Claire, Wis.
National Electrical Manufacturing Company, Milford, Conn.
New Gaynor Electric Company, Louisville, Ky.
Newton Electric Company, 39, Cortlandt-st, New York
New York Electrical and Development Company, 251-253, William-st, New York
New York Electric Equipment Company, Duane-st, New York
North Manufacturing Company, Denver, Colo.
Oelschlager Bros., 42, East 23rd-st, New York
O'Keenan Electric Manufacturing Company, 45 Broadway, New York
Ongley Electric Company, 1, Broadway, New York
Orient Electric Company, Youngstown, O.
Ostrander (W. R.) & Co, 204, Fulton-st, New York
Paiste, H. T., 10, South 18th-st, Philadelphia, Pa. (*See also* Reyrolle (A.) & Co, *in* BRITISH DIVISION)
Pennsylvania Machine Company, 29, North 7th-st, Philadelphia, Pa.
Peru Electric Manufacturing Co., Peru, Ind.

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Philadelphia Electrical and Manufacturing Company, 205, Harket-st. Philadelphia, Pa.
Porter, H. K., 66, Beverly-st, Boston, Mass.
R. I. Telephone and Electric Company, 33, Beverly-st, Providence, R. I.
Ringler (F. A.) & Co, 21, Barclay-st, New York
Robinson Machine Company, Altoona, Pa.
Rockford Electric Manufacturing Company, Rockford, Ill.
Safety Electrical Company 88, Mechanic-st, Newark, N.J
Schultz (G. W.) & Co, 308, Walnut-st, Philadelphia, Pa
Shaw (J. Elliott) & Co, 632, Arch st, Philadelphia, Pa.
Simons (M. W.) Electric Company, Plymouth, Ind.
Sloss-Stein Electric Company, 85, Dearborn-st, Chicago, Ill.
Smith & Shaw Electric Company, 610, Eighth-avenue, New York
Southern Electric Company, 201-203, North-st, Baltimore, Md.
Southern Electrical Manufacturing and Supply Company, Limited, New Orleans, La.
Stanley Electric Manufacturing Company, Pittsfield, Mass.
Starr Electrical Company, 6, Wall-st, New York
Stevenson-Hoggson Electric Company, 919, Olive-st, St. Louis, Mo.
St. Louis Battery Manufacturing Company, 707, Locust-st, St. Louis, Mo.
Stoelting (H. C.) Manufacturing Company, 62-66, S. Canal-st, Chicago, Ill.
Swaney Electric Company, East Liverpool, O.
Teeple Electrical Construction Company, 136, Liberty-st, New York
Technic Electrical Works, Provident-bldg, Philadelphia, Pa.
Tice-Lintner Electric Company, Edison-bldg, Minneapolis, Minn.
Ticonderoga Machine Company, Ticonderoga, N.Y.
Tod-Applegate Company, 313-315, Dearborn-st, Chicago, Ill.
Trenton Electrical Construction Company, Trenton, N.J.
Ulary, W. A., 1018, Chestnut-st, Philadelphia, Pa.
Union Electric Manufacturing Company, Bridgeport, Conn.
Union Electric Works, 207, S. Canal-st, Chicago, Ill.
Varley Duplex Magnet Company, 64, Cortlandt-st, New York
Viaduct Manufacturing Company, Telephone-bldg, Baltimore, Md.
Whalen (John B.) & Co., Sycamore, Ill.
Werner & Wood, 18-30, W. Randolph-st, Chicago, Ill,
Wilkinson and Tinkham, 24, Beach-st, Boston, Mass.
Wilson and Jackson, Times-bldg, Chicago, Ill.
Woonsocket Electric Machine and Power Company, Woonsocket, R.I.
Yearsley-Harris Electric Company, Second and Ledger-place, Philadelphia, Pa.
Ziegler Bros, 73, Federal-st, Boston, Mass.

ELECTRICAL ENGINEERS (Consulting.)

Acheson, E. G., Carborundum Company, Monongahela City, Pa.
Aldrich, William S., F. O. Box 258, Morgantown, W. Va.
Alexander-Chamberlain Electric Company, Aldrich-court, 45, Broadway, New York
Alexander, Harry, 126, Liberty-st, and 340, West 145th-st, New York
Alexander P. H., 808, Equitable-bldgs, Baltimore, Md.
Allen, William R., 225, Dearborn-st, Chicago, Ill.
Almon G. H., 136, Liberty-st, New York
Altenberg, G. P., 65, Smith-bldg, Cincinnati, O.
Anderson J., jun., Fabrica del Gas, Monte Video
Appleton, Thomas, Rialto-bldg, Chicago, Ill.
Arizpe, Rafael R., 6, Calle del 5 de Mayo, Mexico
Arnold, B. J., 565, The Rookery, and 4128, Prairie-avenue, Chicago, Ill.
Badt, Lieut. F. B., (Manager Western Power and Mining Department) General Electric Company, 173, Adams-st, Chicago, Ill. (Author of "Badt's Electrical Handbooks")
Bailey, Theodore P., Railway Department, General Electric Company, 148, Michigan-avenue, Chicago, Ill.
Bailey, W. E., 7-8, Equitable-bldg, St. Louis Mo.
Bain, Foree, Great Western Manufacturing Company, 195-197, South Canalst, Chicago, Ill.
Ball, W. D., Room 110, 115, Dearborn-st, Chicago, Ill.
Barbour, F. F., Manager Power and Mining Department, General Electric Company, 15, Firstst, San Francisco, Cal.
Barriett, S. L., 161, Washington-st, New York
Bart-Bartoshevitch, A., Westinghouse Electric and Manufacturing Company, 160, Arch-st, Alleghany City, Pa.
Batchelor, Charles, 33, W. Twenty-Fifth-s , New York
Bates, F. C., 50, Broadway, New York
Bates, James H., 321, Hudson-st., Hoboken, N.J.
Batesan & Hays, Englewood, Ill.
Battenburg & Jones, 435, The Rookery, Chicago, Ill.
Bauer, A. H., Pullman Palace Car Company, Room 310, Pullman-bldg, Chicago, Ill.
Bauer, W. F., 62, Steuben-st, Orange, N.J.
Beausire, A., Manager, Compania Nacional "Luz Electrica," 108, Calle Cerrito, Monte Video
Becker Bros, 43, W. Washington-st, Chicago Ill.
Beckerleg, James G , 229, South Franklin-st, Chicago, Ill.
Bemis & McLennan, Chemical Bank-bldg, 85 Dearborn-st, Chicago, Ill.
Bentley, Edward M., Patent Department, General Electric Company, Boston, Mass.
Bigby, W. S., 25-27, Bedford-st, Brooklyn, N.Y.
Billberg, C., 3200, Arch-st, Philanelphia, Pa.
Bindemann, Harry, Casilla 556, Valparaiso, Chili
Birdsall, E. T., 18, Broadway, New York
Black, Charles N., Brush Electric Company, Belden-avenue, Cleveland, O.
Blades, Harry H., Detroit Motor Company, 1343-1355, Cass-avenue, Detroit, Mich.
Blake, Francis, Auburndale, Mass.

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Blackwell, F. O., Power and Mining Department, General Electric Company, Lynn, Mass.
Bliss Engineering Company, Atlantic-bldgs, Washington, D.C.
Blodgett, G. W., Boston and Albany Railroad, Boston, Mass.
Blood, J. B., Railway Engineering Department, General Electric Company, Lynn, Mass.
Blood, W. H., jun., Franklin Electric Company, Kansas, Mo.
Bogue, C. J., 140, Winchester-avenue, New Haven, Conn.
Bosch, Adam, Newark, N.J. (Superintendent Fire Alarm Telegraph)
Bottomley, Harry, Marlborough Electric Company, Marlborough, Mass.
Boynton, Edward C., jr., M.E., Erie, Pa.
Boynton, E. M., West Newbury, Mass.
Bradley, C. S., General Electric Company, Lynn, Mass.
Bradly, F. W., 104, Michigan-avenue, Chicago, Ill.
Bratey, George A., American Railroad Improvement Company, 95, Milk-st, Boston, Mass.
Brigham, Archie V., 2742, Washington-avenue, St. Louis, Mo.
Briner, C. J., 515, Walnut-st, St. Louis, Mo.
Brooks, Morgan, Electrical Engineering and Supply Company, 249 Second-avenue, Minneapolis, Minn.
Brophy, William, 35, Milk-st, Boston, Mass.
Brown, Alex. S., 39, Cortlandt-st., New York
Brown, Alfred S., Western Union Telegraph Company, 195, Broadway, New York
Brown, C. A., 1445-1451, Monadnock-bldg, Chicago, Ill.
Brown, Harold P., General Electric Company, Edison-bldg, New York
Brown, James, Direct United States Cable Company, 40, Broadway, New York
Brown, J. Stanford, Neftel O'Connor & Company (Incorporated), 126, Liberty-st, New York
Browning, Victor Reed, Short Electric Railway Company, Monadnock-bldg, Chicago, Ill.
Brush, Charles F., Brush Electric Company, 956, Euclid-avenue, Cleveland, Ohio.
Bryan, William H., 1, Turner-bldg, St. Louis, Mo.
Brydges, J. K., Thomson-Houston Electric Company, Augusta, Ga.
Bulkley, J. Norman, Pennsylvania General Electric Company, Scranton, Pa.
Bubert, J. F., Mather Electric Company, 116, Bedford-st, Boston, Mass.
Burton, Geo. D., 194, Washington-st., Boston, Mass.
Bussey, Robert D., jun., 327, Washington-st, Buffalo, N.Y.
Byllesby, Henry M., North West General Electric Company, 1403, Sibley-st., St. Paul, Minn.
Cahoon, James B., General Electric Company, 68, Baker-st, Lynn, Mass.
Caldwell, Fordyce S., 503, Delaware-st., Kansas City, Mo.,
Canfield, Milton C., 18, Clinton-st, Cleveland, O.
Carpenter, Eugene F., United Gas Improvement Company, Concord, N.H.
Cartwright, F. G., 35, New Montgomery-st., San Francisco, Cal.
Cass & Co, 423, E. North-avenue, Chicago, Ill.
Casper, Louis, Sheridan, Wyo.
Cassels, W. R., Compañia Electricidad de Rio de la Plata, 858, Calle Cangallo, Buenos Ayres
Chamberlain, J. C., 44, Broad-st, and 135, East 18th-st., New York
Chapin, Charles E., 416, Electrical Exchange-bldg, New York
Chase, E. O., 46-54, Lawrence-st, Newark, N.J.
Cheever, Charles A., 13, Park-row, New York
Chesley Electric Company, 171, Broadway, New York
Cheney, F. A., 222, Railroad-avenue, Elmira, N.Y.
Chesney, C. C., Stanley Electric Manufacturing Company, Pittsfield, Mass.
Child, Frank W., 115, Broadway, New York
Chinnock, C. E., 137, Sixth avenue, Brooklyn, N. Y.
Chism, George F., Standard Engineering Company of North America, 92, State-st, Albany, N.Y.
Christmas, Adolph Frederick, Johnson Company, Johnstown, Pa.
Churchill, Arthur, 5, South Church-st, Schenectady, N.Y.
Clarke, Charles L., Greenwich, Conn.
Claus (P.) Dynamo Company, 550-552 West Thirty-sixth-st, New York
Clement, Lewis M., 1,013, Central Avenue, Oakland, Cal.
Cleveland, W. B., 309, Perry-Payne-bldg, Cleveland, O.
Clunn, C. S., 1217, Filbert-st, Philadelphia, Pa.
Colburn, Ralph, Holliston, Mass.
Colby, E. A., Lock Box 313, Newark, N.J.
Colgate, Geo. L., 136, Liberty-st, New York
Comstock (L. K.) & Ball (W. D.), 1419-1433, Monadnock-bldg, Chicago, Ill.
Condict, G. H., 4720, Green-st, Germantown, Philadelphia, Pa.
Connell, William, 37, Hazlewood-avenue, Pittsburgh, Pa.
Cornell, Charles L., Cornell Engineering Company, 45, Broadway, New York
Cornish, J. T., Companhia Luz Electrica, São Carlos do Pinhal, Estado de São Paulo, Brazil
Cowles, Joseph W., General Electric Company, 620, Atlantic-av, Boston, Mass.
Cowles, A. H., 656, Prospect-st, Cleveland, O.
Cox, Ernest Spencer, c/o Messrs. Burlamacchi-Vinci y Cia, Calle Rivadavia 283, San Juan, Argentine Republic
Crane, F. N., 179, Market-st, Newark, N.J.
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Hess Electrical Company, Des Moines, Ia.
Hill Clutch Works, Cleveland, Ohio; 18, Cortlandt-st, New York; and Chicago, Ill.
Hoffman (Frank) & Co, 94, La Salle-st, Chicago, Ill.
Howard (Hiram M.) & Co, 133, West 2nd-st, Cincinnati, O.
Howe Electric Construction Co, Norwalk, O.
Hunt (C. W.) Company, 45, Broadway, New York
Hunter (J. F.) & Co, 33, Church st. New York
Hyland, Huggins, Hammond, & Co, Caixa 291, São Paulo, Brazil
Inman Brothers Construction Company, 136, Liberty-st, N.Y.
Iowa Electric and Construction Company, 808, Walnut-st, Des Moines, Iowa
Johnson Electric Service Co, Milwaukee, Wis.
Kendall (M. K.) & Co, 8, Oliver-st, Boston, Mass.
Kessner & Dorris, 15 and 15½, Mechanic-st, Newark, N.J.
Kester Electric Company, 173, South Canal-st, Chicago, Ill.; and Terre Haute, Ind.
Knauff (Theo. C.) & Co, Newark, Del.
Knox Electric Company, Haverhill, Mass.
Langstad, Peterson, & Croswell, Appleton, Wis.
Lincoln Electric Company, Cleveland, O.
Little (F. P.) Electric Construction & Supply Company, East Seneca-st, Buffalo, N.Y.
Long Island Electric Construction and Equipment Company, Brooklyn, N.J.
Loveridge (H. B.) & Bros, 105, Alder-st, Portland, Ore.
Lynchburg Electric Company, Lynchburg, Va.
McKay (W. H.) & Co, Roanoke, Va.
McKenna, Ryan & Sons, Pittsburg, Pa.
Massachusetts Electrical Engineering Company, 4, Post Office-square, Boston, Mass.
Masters Electrical Company, 316, Main Arcade, Evansville, Ind.
Mechanics' General Manufacturing Company, St. Paul, Minn.
Minneapolis Electric and Construction Company, 27, South Fourth-st, Minneapolis, Minn.
Mitchell, Vance & Co, 836, Broadway, New York
Mortimer Norden Electrical Company, 4, East 60th-st, New York

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Nassau Electrical Manufacturing Company, Milford, Conn.
Nebraska Electrical Manufacturing Company, 1519, Harnay-st, Omaha, Neb.
Neftel, O'Connor & Company (Incorporated), 126, Liberty-st, New York
"New Century" Electric Company, 21 to 25, Bethune-st, New York
Oakes (Roland T.) Co (Incorporated), 366, High-st, Holyoke, Mass.
Ohio Construction Company, 54, Franklin-st, Cleveland, O.
Orr & Howe Electric Company, 423, Smithfield-st, Pittsburgh, Pa.
Overton (E. L.) & Co, 830, Kansas Ave, Topeka, Kansas
Pacific Electric and Contracting Company, 426, Haigh-st, San Francisco, Cal.
Paine (Charles) & Sons, 71, Broadway, New York
Pan-American Engineering and Supply Company, 136, Liberty-st, New York
Pennsylvania General Electric Company, 509, Arch-st, Philadelphia, Pa.
Peterson Electrical Works, 256, Grove-st, Milwaukee, Wis.
Pierce (O. D.) & Co, 806, Walnut-st, Philadelphia, Pa.
Pierce & Miller Engineering Company, 42, Cortlandt-st, New York
Pinkham Electric Company, 27, South 11th-st, Philadelphia, Pa.
Portland General Electric Company, Portland, Ore.
Post-Glover Electric Company, 215, West Fourth-st, Cincinnati, O.
Pullman Electric Company, 44, S. Jefferson-st, Chicago, Ill.
Q. & C. Company, Phœnix-bldg, Chicago, Ill.
Randolph & Sullinger, Nassau Chambers, Nassau-st, New York
Redding (Jerome) & Co, 48, Hanover-st, Boston, Mass.
Riker Electric Motor Company, 45 and 47, York-st, Brooklyn, N.Y.
Robertson (A. C.) & Co, Wilkesbarre, Pa.
Robinson Electric Company, 478, Broadway, Albany, N.Y.
Rodriguez, M. R., 17 and 19, Whipple-st, Brooklyn, N.Y.
Roebling (J. A.) Sons Company, Trenton, N.J., and at New York, Chicago, Ill.
Roller, Lieut John E., U.S. Navy Yard, New York
Royal Electric Company, 909-911, South Washington-st, Peoria, Ill.
Russell Electrical Manufacturing Company, 212, Eddy-st, Providence, R.I.
Russell & Officer, 1735, Champa-st, Denver, Colo.
Rushmore, S. W., 24, Morris-st, Jersey City, N.J. : and 29, Liberty-st, New York
Ryan & Macdonald Construction Company, Baltimore, Md.
San Francisco Electric Storage Company, San Francisco, Cal.
Sawtell Electric Company, 10, Shawmut-bldg, 146, Franklin-st, Boston, Mass.
Sawyer-Man Electric Company, 620, Atlantic-avenue, Boston, Mass.
Scholl (Julian) & Co, 126, Liberty-st, New York
Sechrist (Albert) & Co, Denver, Colo.
See (A. B.) Manufacting Company, 966½, Bergen-st, Brooklyn, N.Y.
Seeley (Elisha B.) & Co, 1226, Chestnut-st, Philadelphia, Pa.
Seely and Taylor Manufacturing Company, 24, Cortlandt-st, New York
Shepard & Searing, 513-514, Mining Exchange, Denver, Colo.
Siemens & Halske Electric Company, Monadnock-bldg, Chicago, Ill.
Slade (H. L.) & Co, 134, Congress-st, Boston, Mass.
Southern Engineering Company, 236, Fifth-st, Louisville, Ky.
Sperry Electric Company, 195-207, Canal-st, Chicago, Ill.
Standard American Electric Company, 140, Winchester Avenue, New Haven, Conn.
Standard Electric Company of Vermont, St. Johnsbury, Vermont ; 161, Franklin-st, Boston, Mass. ; and 286, Pearl-st, New York
Standard Electrical Works, 161-165, W. Pearl-st, Cincinnati, Ohio
Stanton, C. H. & H., 132-134, South Third-st, Philadelphia, Pa.
Star Electric Company, Dubuque, Iowa
Stephens-Miles Electric Company, 181, Elm-st, Cincinnati, O.
Stern & Silverman, 707, Arch-st, Philadelphia, Pa.
Stone & Webster, 4, Post Office-sq, Boston, Mass.
Stucky & Heck Electrical Manufacturing Co, 23, N.J. Railroad-Avenue, Newark, N.J.
Swift (H. E.) Manufacturing Company, 1, Hartford-st, Boston, Mass.
Syracuse Electrical and Manufacturing Company, Syracuse, N.Y.
Taylor & Walsh, 100, S. Fifth-avenue, New York
Thomas & Kellogg, 1006, Pontia-bldg, Chicago, Ill.
United Columbian Electric Company, Kingston, N.Y.
United Electric Improvement Company, 838, Drexel-bldg, Philadelphia, Pa.
Universal Electric Company, 739-741, Cedar-avenue, Cleveland, O.
Universal Electric Company, Equitable-bldg, and Broad-st, Boston, Mass. ; and Portland, Me.
Waite and Bartlett Manufacturing Company, 143, East Twenty-third-st, New York
Westinghouse, Church, Kerr & Co, 17, Cortlandt-st, New York
White (J. G.) & Co, 29, Broadway, New York
Wing (L. J.) & Co, 126, Liberty-st, New York
Wisconsin Electrical Construction Company, Milwaukee, Wis.
WOODHOUSE AND RAWSON UNITED, Limited, 36, Wall-st, New York **See Advt., p. 55.** (*See also* BRITISH DIVISION)
Woodward Electrical Company, 69, Griswold-st, Detroit, Mich.
Woolf Electrical Company, 104, Washington-st, New York
Wright Electrical Engineering Company, Estes Press-bldg, 196, Summer-st, Boston, Mass.

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ELECTRICAL EXPERTS.

Armstrong, Chas. G., 1301, Auditorium-bldg, Chicago, Ill.
Barnes, Edward A., Fort Wayne Election Company, Fort Wayne, Ind.
Bates, Joseph, Minneapolis, Minn.
Benbow, Wm. C., General Electric Company, Atlanta, Ga.
Benjamin, Park, 203, Broadway, New York.
Binney, Harold, 38, Park Row, New York
Bishop, J. D., 234, W. 29th-st, New York
Bliss, G. H., Room 700 and 701, No. 56, Fifth-avenue, Chicago, Ill.
Bohm Ludwig K., Ph.D., 81, Nassau-st, New York.
Braddell, Alfred E., 308, Walnut-st, Philadelphia, Pa.
Burnett, Douglas, B.Sc., 42, Livingston-st, Brooklyn, N.Y.
Cary, Edward E., Beacon Vacuum Pump and Electrical Company, Harcourt-bldg, Irvington-st, Boston, Mass.
Clohesy, Thos. F., 805, N.Y. Life-bldg, Kansas City, Mo.
Coleman, Clyde, Electrical Speciality Co., 85, Fifth Avenue, Chicago, Ill.
Craig, J. Hally (Cummer, Craig & Co.), John Hancock-bldg, Boston, Mass.
Currie, Stanley, B.A., Drexel-bldg, Philadelphia, Pa.
D'Infreville, Georges, 10, Desbrosses-st, New York
Everest, Augustine R., Thomson Electric Welding Company, Lynn, Mass.
Johnson Standardising Company, 42 and 44, Broad-st, New York.
Knight Bros., Fulton-bldg, Fulton and Nassau-st, New York.
Land, Frank, General Electric Company, Lynn, Mass.
Ligget, J. C., Michigan Insurance and Inspection Bureau, Detroit, Mich.
Low, Geo. P., Pacific Insurance Union, P.O. Box 2115, and 303, California-st, San Francisco, Cal.
Lozier, Robert T. E., General Electric Company, Edison-bldg, New York
Nickerson, William E., Cambridge, Mass.
Pearce, G. Wilfred, 44, Murray-st, New York
Pope, Read & Rogers, 39-41, Cortlandt-st, New York
Pope, Franklin L., 39-41, Cortlandt-st, New York
Reed & McKibbin, 2, Wall-st, New York
Shaughnessy, Frank, Depôt-st, Concord, N.H.
Sorley, Charles, 1563, Monadnock-bldg, Chicago, Ill.
Varley, Richard, jun., 64, Cortlandt-st, New York
Wakefield Electrical Engineering Company, 731, Reading Terminal, Philadelphia, Pa.
Walker, Geo. W., General Electric Company, Edison-bldg, New York
Warfield (S. D.) Co, 336, North-st, Baltimore, Md.
Wurts, Alexander Jay, Westinghouse Electric and Manufacturing Co, Pittsburgh, Pa.
Wheeler, Schuyler S., Sc.D., 39, Cortlandt-st, New York
Wintringham J. P., 36, Pine-st, New York

ELECTRICAL INSPECTORS.

Haskins, C. C., 582, W. Congress-st, Chicago, Ill. (To the City)
Ligget, J. C., Michigan Insurance and Inspection Bureau, Detroit, Mich.
Low, Geo. P., 303, California-st, San Francisco, Cal. (To the Pacific Insurance Co.)
Norton, Elbert Fayette, 15, City Hall, Chicago, Ill. (To the City)
Wright, Peter, United Gas Improvement Company, C. Drexel-bldg, Philadelphia, Pa.

ELECTRICAL INSTRUMENT MAKERS.

Ahlstrom, Oscar G., 162, William-st, New York
Aloe (A. S.) & Co., 425, N. Broadway, St. Louis, Mo.
Arnoux-Hochhausen Electric Co., 475-480, Pearl-st, New York
Cleveland Surgical and Electrical Instrument Company, Cleveland, O.
Degroot Electric Co., 66, Liberty-st, New York
Nassau Electrical Company, 112, White-st, New York
Pearce, Frederick, 79, John-st, New York.
Standard Electric Supply Company, 180, Summer-st, Boston, Mass.
Weston Electrical Instrument Company, 114 to 120, William-st, Newark, N.J.
Whitney Electrical Instrument Co., Penacook, N.H.: and Boston, Mass.

ELECTRICAL SECURITIES, DEALERS IN.

Bliss, George H., Room 700 and 701, No. 56 Fifth-avenue, Chicago, Ill.

ELECTRICAL SPECIALITIES, MAKERS OF.

Boston Braid Manufacturing Co., 27, Beach-st, Boston, Mass.
Blaisdell (P.) & Co, 62, Jackson-st, Worcester, Mass.
Burt & Tobey, 23, Middle-st, New Bedford, Mass.
Deming Automatic Electric Safety System, 12, Waverley-pl, New York
Edson, Jarvis B., 87, Liberty-st, New York
Gillet Electric Company, Red Bank, N.J.
Hibbard, W. H., 45, York-st, Brooklyn, N.Y.
Knapp Electric & Novelty Co., 34, Warren-st, New York
RIES ELECTRIC SPECIALTY COMPANY, (Incorporated), 7, South Gay-st, Baltimore, Md.

ELECTRICAL SUPPLIES, MAKERS OF & DEALERS IN.

Acme Specialty Company, 78, Cortlandt-st, New York
Adams (Frank) Electric Company, 807, Market-st, St. Louis, Mo.
Akron Electrical Manufacturing Company, Akron, O.
Allen-Hussey Company, 225, Dearborn-st, Chicago, Ill.
American Electric Supply Company, 226, Pearl-st, Buffalo, N.Y.
American Manufacturing and Engineering Company, 143, Liberty-st, New York
Ames, Ebert & Co, St. Paul, Minn.
Anderson, Homer, South-st, Peekskill, N.Y.

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Angier & Kennard, 519, Monadnock-bldg, Chicago, Ill.
Archer & Rushing, 1825, Monadnock-bldg, Chicago, Ill.
Auburn Electric Motor Company, Auburn, Me.
Baquie, George, 140, Gravier-st, New Orleans, La.
Baxter, H. E. & C., Bedford, Mass.
Beltman (B.) & Co, Cincinnati, O.
Bly, Charles L., 37, Pearl-st, Boston, Mass.
Bohn, Christian C., 1486, Broadway, New York
Buchel Machine Works, 101, Conti-st, New Orleans, La.
Burkett J. C., Washington, D.C.
Bush (Charles S.) & Co, 20, Exchange-place, Providence, R.I.
Callman (W. C.) & Co, 136, Liberty-st, New York ; and Newark, N.J.
Carlisle Manufacturing Company, Carlisle, Pa.
Central Electric Company, 116 & 118, Franklin-st, Chicago, and Peoria, Ill.
Chamberlain, F. H., Metropolitan Railroad Company, 2411, P.-st, N.W. Washington, D.C.
Chase, M. C., 43-45, S. Canal-st, Chicago, Ill.
Clark & Marshall, 345, The Rookery, Chicago, Ill.
Clemens Electrical Manufacturing Company, Attleboro, Mass.
Cleveland Electrical Manufacturing Company, 837, Sheriff-st, Cleveland, Ohio
Cleveland General Electric Company, Cleveland, O.
Cleverly Electrical Works, 1018, Chestnut-st, Philadelphia, Pa.
Cole (La Fayette) & Co, Crocker-bldg, San Francisco, Cal.
Columbia Manufacturing Company, Seattle, Wash.
Compton, Alfred G., 17, Lexington-avenue New York
Copeland (E. T.) & Co, 106, Liberty-st, and 111, Cedar-st, New York
Crandell Manufacturing Company, 66, North 4th-st, Philadelphia, Pa.
Crouch Electric Supply Company, Portland, Ore.
Cutter Electrical and Manufacturing Company, 27, South Eleventh-st, Philadelphia, Pa.
D. & D. Electric Manufacturing Company, 745-747, Washington-avenue, Minneapolis, Minn.
Dahl Electric Company, 120, Liberty-st, New York
Dallas Electrical Construction Company, Dallas, Texas
Day (Thomas) & Co, 222, Sutter-st, San Francisco, Cal.
Denison Electrical Engineering Company, 65, Orange-st, New Haven, Conn.
Detroit Electric Manufacturing Co, 132 to 140, Brush-st, Detroit, Mich.
DIAGO, FREDERIC C., 30, Oficios-st. P.O. Box 278, Havana, Cuba. **See Advt., p. 496**
Drake, Payson & Whittier Electric Company, Providence R.I.
Electric Construction Company, St. Joseph, Mo.
Electric Supply Company, Fisher's-lane, Germantown, Philadelphia, Pa.
Electric Supply and Contracting Company, Nevada-bldg, Cincinnati, O.
Electric Supply and Engineering Company, Detroit, Mich.
Electrical Engineering Company, 249, Second-avenue South Minneapolis, Minn.
Electrical Machine Company, 1008, Title and Trust-bldg, Chicago, Ill.
Electrical Specialty Company, 18 and 20, Cortlandt-st, New York
Electrical Supply and Construction Company, Bay City, Mich.
Electrical Supply Company, 328, Bush-st, San Francisco, Cal.
Electrical Supply and Construction Company, 947, Liberty-st, Pittsburg, Pa.
Engineering Equipment Company, 143, Liberty-st, New York ; and Boston, Mass.
Enterprise Construction and Supply Company, Limited, New Orleans, La.
Fitt's (Frank E.) Manufacturing and Supply Company, Boston, Mass.
Fletcher & Fletcher Electric Company, 9, S. Water-st, Cleveland, Ohio
Franklin Electric Company, 120, Randolph-st, Chicago, Ill.
Gaston Electrical Manufacturing Company, Sparta, Ill.
Giroud, Carlos, Calle Maipu 363, Buenos Ayres
Glover Electric Company, 127, West Eighth-st, Cincinnati, O.
Goodhue & Lincoln, 1564, Monadnock-bldg., Chicago, Ill.
Greeley (E. S.) Co, 5 and 7, Dey-st, New York
Gregory, (Chas. E.) & Co, 27-29, S. Jefferson-st, Chicago, Ill.
Grove, Carlos, 183, Calle Zebala, Monte Video
Harding (E. R,), The Rookery, Chicago, Ill.
Harrison & Carey, 801 and 802, Monadnock-bldg, Chicago, Ill.
Hart & Hegeman Manufacturing Company, 190, Pearl-st, Hartford, Conn.
Haupt & Co, 53, Rua Alfandega, Rio de Janeiro, Brazil.
Haynes (G. D.) & Co, 149 and 355, Congress-st, Boston, Mass.
Hoefer, Ernest, 1222, Monadnock-bldg, Chicago, Ill.
Holtzer-Cabot Electric Company, 92, Franklin-st, Boston, Mass.
International Electric Supply and Construction Company, San Francisco, Cal.
Issertel, Henry G., 39, Cortlandt-st, New York
Iona Manufacturing Company, 336, Congress-st, Boston, Mass.
Jones Bros. Electric Company, 30, Court-st, Cincinnati, Ohio
Keystone Electric Company, Cor. 14th and State-sts, Erie, Pa.
La Roche Electric Works, American and Diamond sts, Philadelphia, Pa.
Lawrence Manufacturing Company, Columbus, O.
Lieb Machine Works, 23, Vandewater-st, New York
McCreary Electrical Specialty Company, 136, Liberty-st, New York
McLean Engineering Company, 136, Liberty-st, New York
Manhattan Electrical Supply Company, 36, Cortlandt-st, New York
Manning, Maxwell & Moore, 111 and 113, Liberty-st, New York

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Mansfield Electrical Manufacturing Company, Mansfield, O.
Massachusetts Manufacturing and Electrical Supply Company, Chelsea, Mass.
Midland Electric Company, Denver, Colo.
Moore Electrical Manufacturing Company, West Thirteenth-st (corner Hudson-street), New York
Mountain Electrical Manufacturing and Construction Company, Meyersdale, Pa.
Nardi, Stang & Company, Philadelphia, Pa.: and Cramer Hill, N.J.
National Electric Company, 1231, Filbert-st, Philadelphia, Pa.
National Electric Manufacturing and Construction Company, Electrical Exchange-bldg, New York
Nebraska Electric Company, Omaha, Neb.
New Jersey Electrical Company, 921, Broad-st, and 10, West-st., Newark, N.J.
New York Electrical Works, 161, Washington-st, New York
North West Electric Manufacturing Company, Portland, Ore.
Northern Electrical Supply Company, Concord, N.H.
Novelty Electric Company, 50-54, North Fourth-st, Philadelphia, Pa.
Partrick & Carter Company, 125, South Second-st, Philadelphia, Pa.
Peninsular Electric and Engineering Company, 97, Ottawa -st, The Grand Rapids, Mich.
Pettingell-Andrews Company, 192-202, Summer-st, Boston, Mass.
Petty (W. M.) and Company, Rutherford, N.J.; and New York
Plumb, (Charles), Electrical Works, 89, Erie-st, Buffalo, N.Y.
Premier Electric Company, 17-19, Whipple-st, Brooklyn, N.Y.
Queen & Co. (Incorporated), 924, Chestnut-st, Philadelphia, Pa.
Reliance Electric Company, 720, Sansom-st, Philadelphia, Pa.
Revere Rubber Company, Chelsea and Boston, Mass.
Ridlon (Frank) & Co, 196, Summer-st, Boston, Mass.
Robinson (J. K.) & Co, 146, Franklin-st, Boston, Mass.; and Broadway, New York
Robinson and Carey Company, St. Paul, Minn.
Royce & Marean, 1408, Pennsylvannia-avenue, Washington, D.C.
Sibley (C. C.) & Co, 416-418, West Twenty-Sixth-st, New York
Siegrist (J. H., jun.) & Co, 313, Olive-st, St. Louis, Mo.
Siemens & Halske Electric Co, Monadnock-bldg, Chicago, Ill.
Sioux City Electrical Supply Company, Sioux City, Iowa
Smith (Harry S.) & Co, Limited, 607, Chestnut-st, Philadelphia, Pa.
Smith & Wallace, 8, Oliver-st, Boston, Mass.
Southern Electrical Manufacturing and Supply Company, Limited, 111, Baronne-st, New Orleans, La.
South-Western Electrical Supply Company, 910-911, New York Life-buildings, Kansas City, Mo
Sun Arc Light Company, 203, South Canal-st, Chicago, Ill.
Taylor, Dee & Ames, 348, Dearborn-st, Chicago, Ill.
Texas Electric Brokerage Co, North Texas National Bank-bldg, Dallas, Texas
United Electric Company, Salt Lake City, Utah; and 40, Wall-st, New York
Utica Electric Manufacturing Co, Utica N.Y.
Werline Manufacturing Company, Clark-avenue, York, Pa.
Wharton (Wm., jun.) & Co, Philadelphia, Pa.
White (R. J.) Manufacturing Co, 40-42, State-st, Chicago, Ill.
Wolfe Electrical Company, 1614, Capital-avenue, Omaha, Neb.
WOODHOUSE & RAWSON, United, Limited, 36, Wall-st, New York. **See Advt., p. 55.** (*See also* BRITISH DIVISION)
Woods (G. T.) Manufacturing Company, 138, Liberty-st, New York

ELECTRICIANS (CONSULTING, &c.).

Acheson, E. G., Monongahela City, Pa.
Alexander, Harry, 126, Liberty-st, and 340, West 145th-st, New York
Anthony, Prof. W. A., Vineland, N.J.
Anthony, Watson G., 32½, Webster-st, Newark, N.J.
Ayres, Dr. S. Browne, Professor of Physics, Tulane University, New Orleans, La.
BADT, LIEUT. F. B., Manager Western Power and Mining Department, General Electric Company, 173, Adams-st, Chicago, Ill. (Author of Badt's Electrical Handbooks)
Baillard, E. V., Bay Ridge, N.Y.
Barberie E. T., 2021, Lexington-avenue, New York
Barrett, John A., 89, Liberty-st, New York
Barrett, Prof. John P., Chicago, Ill. (City Electrician)
Barton & Brown, 1445-1451, Monadnock-bldg, Chicago, Ill.
Bedell, Dr. Frederick, Physical Laboratory, Cornell University, Ithaca, N.Y.
Bell, Prof. Alexander Graham, 1336, Nineteenth-st, Washington, D.C.
Bennett, J. C., General Electric Company, Box 3067, Edison-bldg, New York
Blake, Prof. Lucien L., Kansas State University, Lawrence, Kansas
Bliss, Donald M., Holtzer-Cabot Electric Company, 1, Davies-court, Washington-st, Brookline, Mass.
Bocquet, Frank H., Ferro Carril Ensenada, Estacion Central, Buenos Ayres
Bottome, Turner D., Indianapolis, Ind.
Brackett, Prof. C. F., College of New Jersey, Princeton, N.J.
Brooks, H. B., Piqua Electric Company, Piqua, O.
Burleigh, Charles, General Electric Company, 620, Atlantic-avenue, Boston, Mass.
Burnett, Douglass, B.Sc., 42, Livingston-st, Brooklyn, N.Y.
Cabot, John Alfred, City Hall, and 123, Garfield Place, Cincinnati, O.
Caldwell, Ed., A.B., M.E., *Street Railway Gazette*, Monadnock-bldg, Chicago, Ill.

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Carty, J. J., 18, Cortlandt-st, New York
Cassels, Frank, Superintendent River Plate Electricity Company, Limited, 858, Calle Cangallo, Buenos Ayres
Cetta, William J., General Electric Company, 398, Broad-st, Newark, N.J.
Chandler, Prof. Charles F., College of Physicians and Surgeons, New York
Cheney, Frederick A., Elmira Illuminating Company, Elmira, N.Y.
Cheney, W. C., Portland General Electric Company, Portland, Ore.
Chubbuck, H. E., New Omaha General Electric Company, Omaha, Neb.
Clapperton, Geo., 1, Broad-st, New York
Colville, Frank C., N. W. Cor. Seventh-ave and E. 20th-st, Oakland, Cal.
Condict, G. Herbert, 4720, Green-st, Germantown, Philadelphia, Pa.
Cory, Clarence L., University of California, Berkeley, Cal.
Crehore, Dr. Albert C., Dartmouth College, Hanover, N.H.
Cummins, E. C., Western Brazilian Telegraph Company's c.s. "Norseman," Pernambuco, Brazil
Cuntz, J. H., 325, Hudson-st., Hoboken, N.J.
Cushman, Abe L., Granite State Electric Company, 31, S. Main-st, Concord, N.H.
Daft, Leo, Everett, Wash.
DeLand, Fred, 565, The Rookery, Chicago, Ill.
Dolbear, A. E., Ph.D., 620, Atlantic-avenue, Boston, Mass.
Doremus, Dr. Charles A., 92, Lexington-avenue, New York
Dunston, Robert Edward, Room 86, Foster Block, Hartford, Conn.
Eckart, W. R., Box 1844, San Francisco, Cal.
Edgerton, E. M., 201, Sixty-Third-st, Chicago, Ill.
Eustis, Herbert H., Eastern Electric Cable Company, 61, Hampshire-st, Boston, Mass.
Farnham, Isaiah H., 125, Milk-st, Boston, Mass.
Fessenden, Prof. Reginald A., Western University of Pennsylvania, Allegheny, Pa.
Field, Stephen D., Stockbridge, Mass.
Fleming, Wilfrid H., Traske-avenue, Bayonne City, N.J.
Flood, J. F., Superintendent, Steubenville Street Railway Company, Steubenville, Ohio
Fontan, Pablo, Calle Cuyo, 890, Buenos Ayres
Foote Allen R., Takoma Park, D.C.
Foote, Charles W., Society for Savings-bldg, Cleveland, O.
Ford, Wm. S., American Bell Telephone Co., 125, Milk-st, Boston, Mass.
Francisco, M. J., Rutland Electric Light Company, Rutland, Vt.
Freeman, Walter K., 53, State-st, Boston, Mass.
Gesner, John F., 21, State-st, New York
Geyer, Prof. W. E., Stevens' Institute of Technology, Hoboken, N.J.
Ghegan, J. J., 210, Garside-st, Newark, N.J.
Gilliland, E.T., P.O. Box 56, Pelham Manor, N.Y.
Gray, Dr. Elisha, Highland Park, Ill.
Gray, Prof. T., Rose Polytechnic Institute, Terre Haute, Ind.
Grier, Dr. M. J., 1531, Spruce-st., Philadelphia, Pa.
Grill, Enrique, 177, Calle Suipacha, Buenos Ayres
Grower, G. G., Ansonia, Conn.
Guy, George H., 533, Temple-court, New York
Halsey, Wm. B., Postal Telegraph Cable Company, 94, Leonard-st, New York
Hamilton, George A., Western Electric Company, 22, Thames-st, New York
Hancock, L. M., Western Electric Company, Thames-st, New York
Handley, F. L., 6, Baron-Block, Watertown, N.Y.
Harding, C. K., Atlantic, Ia.
Hart, W. J., Saginaw, Mich. (To the City Authorities.)
Haskins, Charles H., 80, Broadway, New York
Haskins, Carlyle D., General Electric Company, 620, Atlantic-avenue, Boston, Mass.
Hochhausen, Wm., 196, Willoughby-st, Brooklyn, N.Y.
Houston, Prof. E. J., 1809, Spring-garden-st, Philadelphia, Pa.
Hubbard, W. C., 136, Liberty-st, New York
Hutchinson, Cary T., Ph.D., Messrs. Sprague, Duncan and Hutchinson, Limited, 15, Wall-st, New York.
Jackson, J. P., Penn. State College, State College, Pa.
Ives, Lieut. E. B., 11th and Colona-sts, and Grand Boulevard, New York
Jacques, William W., Ph.D., 125, Milk-st, Boston, Mass.
James, John N., Naval Observatory, Washington, D.C.
Jones, F. W., Postal Telegraph Cable Company, 5, Dey-st, New York
Judson, Wm. Pierson, Oswego, N.Y.
Kellogg, Jas. W., 140, East Twenty-seventh-st, New York
Kellogg, Milo G., 135, Forty-seventh-st, Chicago, Ill.
Khotinsky, Capt. A. de, Marlborough, Mass.
Kingsford, Herbert, Casilla 120, Lima, Peru
Klees, W. H., Susquehanna, Pa.
Lange, Philip A., Westinghouse Electric Company, Newark, N.J.
LECLANCHÉ BATTERY COMPANY, 111-117, East 131st-st, New York. **See Advt., p. 17**
Lee, J. C., Mountford-st, Longwood, Brookline, Mass.
Liebig, Gustav A., jun, Johns Hopkins University, Baltimore, Md.
Lineff, A. L., 52, Tribune-bldgs, New York
Lloyd, Robert McA., United Electric Traction Company, 2, West Thirty-sixth-st, New York
Loomis, Osborn P., Bound Brook, N.J.
Lumley, F., General Superintendent, Chili Telephone Company, 180, Casilla, Santiago
McCarthy, Lawrence A., Western Union Telegraph Co., 1053, Bedford-avenue, Brooklyn, N.Y.
Macfarlane, Prof. Alex., University of Texas, Austin, Texas
McNeill, David, Secretary to Representative Western and Brazilian Telegraph Company, P.O. Box 53, Rio de Janeiro, Brazil
McGhie, John, General Electric Company, Edison-bldg, Broad-st, New York
Main, Prof. W., Union Electric Co., 45, Broadway, N.Y.

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Mansfield, Geo. W., Railway Department, General Electric Company, 620, Atlantic-avenue, Boston, Mass.
Marks, L. B., Royal Arc Electric Company, 51, E. Sixty seventh-st. New York
Mendenhall, T.C., M.D., U.S. Coast and Geodetic Survey, Washington, D.C.
Mercer, Andrew G., Waterloo Electric Co, Waterloo, N. Y.
Miller, W. C., 3, South Hawk-st, Albany, N.Y.
Miner, William M., 96, Broadway, New York.
Moses, Dr. Otto A., 1037, Fifth avenue, New York
Norton, Elbert Fayette, City Electric Light Inspector, Chicago, Ill.
Nunn, R. J., M.D., 119½, York-st, Savannah, Ga.
Ockershausen, H. A., 65, Madison-avenue, Jersey City, N.J.
Owens, R. B., Nebraska University, Lincoln, Neb.
Parcelle, Albert L., 157, Washington-st, Boston, Mass.
Parks, C. Wellman, c/o U.S. Board of Education, Washington, D.C.
Parshall, H. F., General Electric Company, Lynn, Mass.
Peck, Samuel C., Apartado 694, Mexico.
Perret, Frank A., Elektron Manufacturing Company, Springfield, Mass.
Perrine, F. A. C., Leland Stanford, jn. University, Palto Alto, Cal.
Reckenzaun, Fredk., 58, Demott-st (P.O. Box 225), West Hoboken, N.J.
Reeve, I. M., Citizens' Light, Heat and Power Company, Horton, Kans.
Reilly, John C., 16, Smith-st, Brooklyn, N.Y.
Rice, Edwin W., jun., General Electric Company, Lynn, Mass.
Richmond, W. A., Concord, N.H.
RIES, E. E., Ries Electric Specialty Company, Incorporated, 12, South Gay-st, Baltimore, Md.
Roberts, Prof. N., Swan Lamp Co., Cleveland, O.
Robinson, Almon, P.O. Box 943, Lewiston, Me.
Rodman, Samuel, jun., 17, Quincy-st, Chicago, Ill.
Scott, Campbell, Commerce-bldg, Louisville, Ky.
Scott, Geo. B., 16, Broad-st, New York
Shallenberger, O. B., Westingnouse Electric and Manufacturing Company, Pittsburg, Pa.
Sheddy, J. H., Renovo Edison Light, Heat and Power Company, Renovo, Pa.
Shephardson, Prof. George D., University of Minnesota, Minneapolis, Minn.
Smith, T. Jarrard, E. S. Greeley Co, 5 and 7, Dey-st, New York
Soni, F. A., 31, Apartado en el Correo, Mexico
Stanley, William, Pittsfield, Mass.
Stebbins, Theodore, General Electric Co, 44, Broad-st, N.Y.
Thomas, Prof. Benjamin F., Ohio State University, Columbus, O.
Thompson, Edward P., 5, Beekman-st, New York
Thomson, Prof. Elihu, Lynn, Mass.
Unwin, A. H., Compañia Electricidad del Rio la Plata, Limitada, Casilla 137, Rosario de Santa Fé, Argentine Republic
Vail, Stephen, 18, Cortlandt-st, New York.
Van Buren, Gurdon C., 5, Wilson-st, Albany, N.Y.
Varley, Richard, jun, 64, Cortlandt-st, New York
Weaver, Norman R., Galveston, Texas
Webster, Dr. Arthur G., Clark University, Worcester, Mass
Weems, D. G., Baltimore, Md.
Westinghouse, Geo., jun., Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.
Weston, E., 120, William-st, and 646, High st, Newark, N.J.
Wetzler, Joseph, Editor of *The Electrical Engineer*, 203, Broadway, New York
Willyoung, Elmer G., Queen & Co (Incorporated), 924, Chestnut-st, Philadelphia, Pa.
Wing, Frank A., West Somerville, Mass.
Woolbury, C. J. H., Boston Manufacturers Mutual Fire Insurance Company, 31, Milk-st, Boston, Mass.
Woodward, Francke L., 13, Kirkland-place, Cambridge, Mass.

ELECTRICIANS (MANUFACTURING).

Blodgett, Aaron D., 383, Federal-st, Boston, Mass.
Brush Electric Company Belden-st, Cleveland, O.
Central Electric Company, 116-118, Franklin-st, Chicago, Ill.
Chapman (Geo. M.) and Co. Waterbury, Conn.
Cleveland & Taylor, 5-7, Day-st, New York
Clyde Electric Motor Company, 147, Charles-st, Providence, R.I.
Costillo, J. C., cor. Hudson-avenue, and Concord-st, Brooklyn, N.Y.
Douglas, F. A. formerly of Lockport, N.Y., 719, Peach-st, Erie, Penna.
Eddy Electric Manufacturing Company, Windsor, Conn.; and at New York
Electro Chemical and Specialty Company, 136, Liberty-st, N.Y.
Gardam (William) and Son, 98, John-st, New York
General Electric Company, 620, Atlantic-av, Boston, Mass: and Broad-st, New York
Hard, Liggett & Cooper, 212, Griswold-st, Detroit, Mich.
Hinds, Charles H., Trio-bldg, Thirteenth and Hudson-sts, New York
Hope Electric Appliance Company, Providence, R.I.
Hubbard (Wm. & Company, 94, La Salle-st, Chicago, Ill.
Hussey and Co. 211 and 213, Randolph-st, Chicago, Ill.
Kidder (Jerome Manufacturing Company, 820, Broadway, New York
Meserole and Co. 26, Church-st, New York
Orne Electric Construction Company, 112, Randolph-st, Chicago, Ill.
Partrick & Carter Company, 125, South Second-st, Philadelphia, Pa
Ries Electric Speciality Company (Incorporated, 7, South Gay-st, Baltimore, Md.
Seib & Starke, 411 and 413, E. 107th-st, N.Y.
Weston (Wm. H. & Co., 830, Filbert-st, Philadelphia, Pa.
Wilcox, L. M., 219, Market-st, Newark, N.J.

ENGINES (GAS) MAKERS OF.

Charter—Charter Gas Engine Company, P.O. Box 148, Sterling, and Chicago, Ill.
Otto—Otto Gas Engine Works, 33rd and Walnut sts, Philadelphia, Pa.

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White-Middleton—White and Middleton Gas Engine Company, Baltimore, Md.

ENGINES (HIGH-SPEED), MAKERS OF.

American Engine Company, Bound Brook, N.J.
Buckeye—Buckeye Engine Company, Salem, Ohio
Dick and Church—Phœnix Iron Works Company, Meadville, Pa.; and at New York; and Chicago, Ill.
Bullock (M. C.) Manufacturing Company, 1,170, W. Lake-st, Chicago, Ill.
Payne (B. W.) & Sons, Elmira, N.Y.; Chicago, Ill., and New York
Triumph—Triumph Compound Engine Company, Cincinnati, O.
Weston—Weston Engine Company, Painted Post, N.Y.
Woodbury—Stearns Manufacturing Company, Erie, and Philadelphia, Pa.

ENGINES (STEAM) MAKERS OF.

Ball—Ball & Wood Company, Elizabethport, N.J.
Corliss—Corliss Steam Engine Company, Providence, R.I.
Dick and Church—Phœnix Iron Works Company, Meadville, Pa.; and 15, Cortlandt-st, New York; and 418, Chamber of Commerce, Chicago, Ill.
Fitchburg—Fitchburg Steam Engine Company, Boston, and Fitchburg, Mass.
Greene—Providence Steam Engine Company, 45, Broadway, New York; and Providence, R.I.
Wheelock—Wheelock Engine Company, Worcester, Mass.
Williams—Williams Engine Works, 62, Manufacturer's Record-bldg, Baltimore, Md.
Wilson & Wilson, North Tonawanda, Niagara County, N.Y.

ENGINEERS, CONSULTING.

Askew & Russell, P.O. Box 326, Chicago, Ill.
Conover Manufacturing Co, 95-97, Liberty-st, New York
DAVIS, L. K., 1, Broadway, New York. **See Advt., p. 830**
DIAGO, FREDERIC C., 30, Oficios-st, P.O. Box, 278, Havana, Cuba. **See Advt.,** p. **496**
Idell, F. E., 616, Havemeyer-bldg, New York
Marks, Prof. W. D., Edison Electric Company, Philadelphia, Pa.
Meyer, Julius, 7, Beekman-st, New York
Platt, Joseph C., 35, Wall-st, New York
Seitzinger, H. M., Wilkesbarre, Pa.
Woodbridge & Turner Engineering Company, 47, Times-bldg, New York

ENGINEERS, GENERAL.

Ball Engine Company, Erie, Pa.
Blake and Knowles Steam Pump Works, Limited, 113, Federal-st, Boston, Mass.
Cramp & Co, Philadelphia, Pa.
DAVIS, L. K., 1, Broadway, New York. **See Advt., p. 830**
Field Engineering Company, 143, Liberty-st, New York
Smith, Jesse M., 36, Moffatt-block, Detroit, Mich.
Westinghouse, Church, Kerr & Co, 17, Cortlandt-st, New York.

GOVERNORS AND REGULATORS, MAKERS OF.

Ries Electric Speciality Company (Incorporated), 7, South Gay-st, Baltimore, Md.

INCANDESCENT LAMPS, MAKERS OF.

American—American Electrical Manufacturing Company, 2,011-2,017, Pine-st, St. Louis, Mo.
Anchor—Carter (Geo. G.) & Co, 1,563, Monadnock-bldg, Chicago, Ill.
Baker Electric Lamp Company, Portland, Me.
Bain—Great Western Manufacturing Company, 195-207, South Canal-st, Chicago, Ill.
Ball—Ball Electric Light Company, 404, West 27th-st, New York
Beacon—Beacon Vacuum Pump and Electrical Company, Irvington-st, Boston, Mass.
Bernstein—Bernstein Electric Company, 620, Atlantic-avenue, Boston, Mass.
Boston Incandescent Lamp Company, 70, Pearl-st, Boston, Mass.
Brilliant—Electric Manufacturing Company, Oconto, Wis.; and 239, La Salle-st, Chicago, Ill.
Browne, William L., Plattsmouth, Neb.
Brush-Swan—Brush Electric Company, Belden-st, near Mason-st, Cleveland, Ohio
Buckeye—Buckeye Electric Company, P.O. Box 123, Cleveland, O.; and Boston, Mass.
Colby—Colby, E. A., Newark, N.J.
Columbia—Columbia Incandescent Lamp Company, 1912 and 1914, Olive-st, St. Louis, Mo.
Consolidated Electric Manufacturing Company, 154, Franklin-st, and 155 and 355, Congress-st, Boston, Mass.
Davis Electrical Works, Springfield, and Boston, Mass.
Diamond—Diamond Incandescent Lamp Company, Denver, Colo.
——— Lincoln Electrical Manufacturing Company, Lincoln, Neb.
Duplex—Duplex Electric Company, Limited, Corry, Pa.
Economic—Economic Electric Manufacturing Company, 1, Beacon-st, Boston, Mass.
Edison—General Electric Company, Edison-bldg, New York
General Incandescent Arc Lamp Company, 572-578, First-avenue, New York
Green—Green Electric Lamp Company, Hartford, Conn.
Halbert—Central Electric Company, 116 and 118, Franklin-st, Chicago, Ill.
Howard—Great Western Manufacturing Company, 195-207, S. Canal-st, Chicago, Ill.
——— Connecticut Royal Arc Company, Hartford, Conn.
International—International Trading and Electric Company, 40, Cortlandt-st, New York
Jaeger, H. J., 175, Pearl-st, Brooklyn, N.Y.
Jewel—Hood (Wm.) & Co, 239, La Salle-st, Chicago, Ill.
——— Empire Electric Company, 171, S. Canal-st, Chicago, Ill.

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Loomis—Eureka Electric Company, 18, Broadway, New York
——— Empire Electric Company, 171, S. Canal-st, Chicago, Ill.
McNutt—Bartholomew, Stow & Co, 57, Michigan-avenue, Chicago, Ill.
Maggie Murphy—Pennsylvania Electric Engineering Co., Penn Mutual-bldg, Philadelphia, Pa.
Marks—Royal Arc Electric Company, 143, Liberty-st, New York
Mason—Excelsior Electric Company, 44, Broad-st, New York
Mellick—Mellick, Geo. F., Metuchen, N.J.
New Sunbeam—Star Electric Lamp Company, 102, Michigan-avenue, Chicago, Ill.
Novak—Waring Electric Company, Manchester, Conn.; and 116, Bedford-st, Boss, Mass.
Packard—New York & Ohio Company, Warren, O.
Perkins—Perkins Electric Lamp Company, 116, Bedford-st, Boston, Mass.
——— Pierce (O. D.) & Co., 806, Walnut-st, Philadelphia, Pa.
Phœnix—Callmann (W. C.) & Co, 136, Liberty-st, New York
Pray—Chicago Incandescent Lamp Co., 14, N. Jefferson-st, Chicago, Ill.
Prentiss—Buckeye Electric Company, P.O. Box 123, Cleveland, O
Sawyer-Man—Sawyer-Man Electric Company 620, Atlantic-avenue, Boston, Mass.; and Chicago, Ill.
Schaefer—Schaefer Electric Manufacturing Company, Boston, and Cambridgeport, Mass.
Schuyler—Schuyler Electric Company, Middletown, Conn.
Series—Bernstein Electric Co., 620, Atlantic-avenue, Boston, Mass.
SHAIN, CHAS. D., Selling Agent Star Electric Lamp Company (Sunbeam Incandescent Lamps), 136, Liberty-st, New York
Standard—Standard Lamp and Motor Company, Oconto, Wis.
Stellar—Stellar Electric Company, 13, Doane-st, Boston, Mass.
Stern—Stern Incandescent Lamp Company, Buffalo, N.Y.
Steuben—Steuben Incandescent Lamp Co., Canisteo, N.Y.
Sunbeam—Sunbeam Incandescent Lamp Company, 102, Michigan-avenue, Chicago, Ill.
——— Electrical Supply Company, Chicago, Ill.; and at Ansonia, Conn.
Swan Lamp Manufacturing Company, Cleveland, Ohio
Trophagen, Baker & Co, 251, Market-st, Newark, N.J.
Van Depoele—General Electric Company, 620, Atlantic-ave, Boston, Mass.; and New York
Voss—Voss, D. C., Niles-bldg, Boston, Mass.
Waterhouse—Waterhouse, Gamble & Co., 302, Asylum-st, Hartford, Conn.
Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.
Weston—United States Electric Lighting Company, 120, Broadway, New York
Wolverton—Wolverton Glow Arc Electric Light Company, cor. Independence and Liberty-sts, New York.

INCANDESCENT LAMP SOCKETS AND JOINTS, MAKERS OF.

Hawkeye—Sioux City Electrical Supply Company, Sioux City, Iowa
Ries Electric Specialty Company (Incorporated), 7, South Gay-st, Baltimore, Md.

INSULATING MATERIALS, MAKERS OF.

General.

Belden (E. E.) Mica Mining Company, 12, Broad-st, Boston, Mass.
Bell, A. T., 143, Liberty-st, New York
Bishop Gutta Percha Company, 420-426, East 25th-st, New York. (Gutta Percha)
Delaware Hard Fibre Company, Wilmington, Del.
Conover (C. E.) Insulator Company, 366, Vine-st, Connecticut, O.
H. W. JOHNS MANUFACTURING COMPANY, 87, Maiden-lane, New York City, U.S.A.
Laclede Carbon and Electric Company, Kokomo, Ind.
Massachusetts Chemical Company, 8, Oliver-st, Boston, Mass.; and Chicago, Ill.
Munsell (Eugene) & Co, 218, Water-st, New York
Pass & Seymour, Syracuse, N.Y.
Roessler & Hasslacher Chemical Company, 73, Pine-st, New York
Royal Electrical Speciality Company, 239, Water-st, New York
Vulcanised Fibre Company, 15, Dry-st, New York; and Wilmington, Del.

Moulded Mica (*see* Mica, Moulded).

Vulcabeston.

H. W. JOHNS MANUFACTURING CO, 87, Maiden-lane, New York City, U.S.A.

LABORATORY FURNISHERS.

Western Electrical Instrument Company, 114 to 120, William-st, Newark, N.J.

LAMP HOLDERS, MAKERS OF.

Lamp Socket Manufacturing Company, 39 and 41, Cortlandt-st, New York
Ries Electric Specialty Company (Incorporated), 7 South Gay-st, Baltimore, Md.

MICA, MOULDED (Insulation for Trolley Lines, and Electric Conduit Systems, and Insulators for all purposes).

H. W. JOHNS MANUFACTURING COMPANY, 87, Maiden Lane, New York City, U.S.A.

MAGNET WINDERS, MAKERS OF.

ANDERSON, HOMER, South st, Peekskill, N.Y.

METERS (ELECTRIC), MAKERS OF.

Brush Electric Company, Belden-st, Cleveland, Ohio
Fort Wayne Electric Company, Fort Wayne, Ind.

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General Electric Company, 620, Atlantic-avenue, Boston, Mass; and Broad-st, New York
Hackenthal, W., 21, Beekman-st, New York
Pentz-Reckenzaun—Pentz Reckenzaun Electric Company, 1001, Chestnut-st, Philadelphia, Pa.
Queen & Co, Incorporated, 924, Chestnut-st, Philadelphia, Pa.
SHAIN, CHAS. D., Selling Agent Weston Electrical Instrument Company, 136, Liberty-st, New York
Walker Electric Company, 50, Broadway, New York
Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.
Weston Electrical Instrument Company, 114-120, William-st, Newark, N.J.

PATENT AGENTS AND EXPERTS.

Buckingham, Chas. L., 195, Broadway, New York
DIAGO, FREDERIC C., 30, Oficios-st, P.O. Box 278, Havana, Cuba. **See Advt., p. 496**
Patents, Caveats, Trade Marks, Designs, Copyrights, &c., &c., secured throughout the world.
Dyer, R. N., 36, Wall-st, New York
Edwards, C. V., 177, Times-bldg, New York; and 79, Corcoran-bldg, Washington, D.C.
Jamnus, Frankland, Atlantic-bldg, 928-930 F-st, Washington, D.C.
Lockwood, Thomas D., P.O. Drawer 2, Boston, Mass.
Munn & Co, 361, Broadway, New York
Pope, Read & Rogers, 39-41, Cortlandt-st, New York
Read, Robert H., 39-41, Cortlandt-st, New York
Stockbridge, G. H., 39, Cortlandt-st, New York
Terry, Charles A., 120, Broadway, New York
Thompson, E. P., 3-9, Beekman-st, New York
Townsend, Henry, C., 5, Beekman-st, New York
Tyndall, William D., 170, Broadway, New York
Zimmermann, Wm., 164, Dearborn-st, Chicago, Ill.

PUBLICATIONS, ELECTRICAL.

Electric Power (monthly), 36, Cortlandt-st, New York. Price $3 per annum
Electrical Age (weekly), Room 12-13, World-bldg, New York. Price $4 per annum
Electrical Engineer (weekly), 203, Broadway, New York. (Annual subscription within Postal Union, $5 = £1 1s.)
Electrical Engineering (monthly), 565, The Rookery, Chicago, Ill. (Ann. Sub., P.U. $4)
Electrical Industries (monthly), 351, The Rookery, Chicago, Ill. Price $3 per annum
Electrical Literature (monthly), 565, The Rookery, Chicago, Ill.
Electrical Review (weekly), 13, Park-row, New York. Price $5 per annum
Electrical and Street Railway Reporter (monthly), 136, Liberty-st, New York
Electrical World, The (weekly), 167-177, Times-bldg, New York. Price £1. 5s. per ann.
Electricity (weekly), 16, Park-place, New York, and at Chicago, Ill.; and Boston, Mass. (Ann. sub., P.U., $4.50 = 19s.)
India Rubber World and Electrical Trades Review (monthly), 192, World-bldg, New York. Price $3 = 12s. 6d. per annum
Physical Review (monthly), Cornell University, Ithaca, N.Y. (Ann. Sub. $3)
Power (monthly), 145 and 146, World-bldg, New York. (Ann. Sub. P.U., 6s. 3d.)
Practical Electricity (fortnightly), 620, Atlantic-avenue, Boston, Mass. Price 9s. 6d. per annum
Progressive Age (semi-monthly), 280, Broadway, New York; and at Boston, Mass. (Ann. sub., 13s. 6d.)
Revista Telegraphica de Mexico (twice a month), Calle del Refugio 15, Mexico. Price $5 per annum
Scientific American (weekly), 361, Broadway, New York. Annual subscription, Europe, $4
Scientific American Supplement (weekly), 361, Broadway, New York. Annual subscription, Europe, $6
Transactions of the American Institute of Electrical Engineers (monthly), 12, West 31st-st, New York. Ann. sub., $5
Western Electrician (weekly), 6, Lakeside-bldg, Chicago. Price (P.U.) $5 per annum.

PUBLISHERS.

DIAGO, FREDERIC C., 30, Oficios-st, P.O. Box 278, Havana, Cuba. **See Advt., p. 496**
Johnston (W. J.) Company, 167-177, Times-bldg, New York
Munn & Co, 361, Broadway, New York
Van Nostrand (D.) Company, 23, Murray-st, and 27, Warren-st, New York

RAILWAY AND TRAMWAY (ELECTRIC) ENGINEERS AND CONTRACTORS.

Allen Electric Supply Company, 232-234, Carter-st, Philadelphia, Pa.
American Railroad Improvement Company, 95, Milk-st, Boston, Mass
Astoria Electrical Manufacturing Company, 14, Dey-st, New York. Factory: Astoria, N.Y.
Barry (J. F.) & Co, 52 William-st, New York
Central Power Company, Newark, N.J.
Cleveland Electric Railway Co, Cleveland, O.
Complete Electric Construction Company, 121, Liberty-st, New York
Curtis Electric Manufacturing Company, Pacific-avenue, Jersey City, N J.
DIAGO, FREDERIC C., 30, Oficios-st, P.O. Box 278, Havana, Cuba. **See Advt., p. 496**
Electric Construction and Supply Company, 18, Cortlandt-st, New York
Electric Railway Engineering Company, 180, Summer-st, Roston, Mass.
Electric Tramway Maintenance Company, 1, Broadway, New York
Electrical Conduit Traction Equipment Company, 94, Wall-st, New York
Electrical Construction and Manufacturing Company, 108, North Eutaw-st, Baltimore, Md.
Field Engineering Company, 143, Liberty-st, New York
Lindsay & Wilgus, 59, William-st, New York
Love Electric Traction Company, 817, The Rookery, Chicago, Ill.
McQuesten, William D., 15, Cortlandt-st, New York

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Safety Electric Railway and Power Company, 45 and 47, Wall-st, New York
Schuyler Electric Manufacturing Company, Middletown, Conn.
Short Electric Railway Company, Cleveland, Ohio
Thomson-Houston—General Electric Company, 620, Atlantic-avenue, Boston, Mass.; and at New York
Thomson-Houston International Electric Company, Edison-bldg, New York.
Westinghouse Electric Railway Company, Pullman-bldg, Chicago, Ill.
Wright & Lindsey, 29, Cone-st, Orange, N.J.

RECULATORS, MAKERS OF.

Ries Electric Specialty Company, Incorporated, 77, South Gay-st, Baltimore, Md.

RHEOSTATS, MAKERS OF.

Carpenter Enamel Rheostat Company, Bridgeport, Conn. (Selling Agent: Chas. D. Shain, 136, Liberty-st, New York)
SHAIN, CHAS. D., Selling Agent Carpenter Enamel Rheostat Company, 136, Liberty-st, New York

SCHOOLS AND COLLEGES.

Buffalo College of Commerce (Practical School of Electricity), 327-331, Washington-st, Buffalo, N.Y.
Columbia College (School of Mines), 41, East 49th-street, New York
Cornell University, Ithaca, N.Y.
Highland Park Normal College, Des Moines, Iowa
Johns Hopkins University, Baltimore, Md.
Ohio State University, Columbus, Ohio
Pennsylvania State College, State College, Pa.
Philadelphia Central Manual Training School, Philadelphia, Pa.
Rogers' Laboratory of Physics, Massachusetts Institute of Technology, Boston, Mass.
Stevens Institute of Technology, Hoboken, N.J.
University of Michigan, Ann Arbor, Mich.

SECONDARY GENERATORS (*see* Transformers).

SOCIETIES AND INSTITUTIONS.

American Institute of Electrical Engineers, 12, West 31st-st, New York. (*For List of Officials, &c., see page 776.*)
American Institute of Mining Engineers, 13, Burling Slip, and P.O. Box 223, New York
American Society of Civil Engineers, 127, East 23rd-st, New York
Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanical Arts, 15, South 7th-st, Philadelphia, Pa.
Massachusetts Institute of Technology, Boston, Mass.
National Electric Light Association of America, 136, Liberty-st, New York
National Telephone Exchange Association, 20, Cortlandt-st, New York
New York Electrical Society, 534, Temple-court, New York.

SWITCH AND WALL SOCKET (COMBINED) MAKERS.

Ries Electric Specialty Company (Incorporated), 7, South Gay-st, Baltimore, Md.

SWITCHES, MAKERS OF.

Automatic Switch Company, 703-705, Equitable-bldg, Baltimore, Md.
Edison—General Electric Co, 620, Atlantic-av, Boston, Mass., and Broad-st, New York
Electro-Dynamic Company, 224, Chestnut-st, Philadelphia, Pa.
Fitch—Fitch Excelsior Switch Company, 45, Broadway, New York.
Hart—Hart & Hegeman Manufacturing Co, 190, Pearl-st, Hartford, Conn.
Hays (J. L.) & Co, 830, Liberty-av, Pittsburg, Pa.
Lang (J.) & Co, 44, Michigan-st, Chicago, Ill.
Paiste—Paiste, H. T., 10, South Eighteenth-st, Philadelphia, Pa.
Perkins' Incandescent—Perkins Electric Switch Manufacturing Company, Hartford, Conn.
Ries Electric Speciality Company (Incorporated), 7, South Gay-st, Baltimore, Md.
SHAIN, CHAS. D., Selling Agent, The Cutter Electrical and Manufacturing Co. (Flush Switches), 136, Liberty-st, New York
Star Electrix Company, 1303, Filbert-st, Philadelphia, Pa.
Thomas (R.) & Sons Company, East Liverpool, O.

TELEGRAPH AND CABLE COMPANIES.

Central and South American Telegraph Company, Utica, N.Y.
COMMERCIAL CABLE COMPANY, Washington-bldg, 1, Broadway, New York. **See Advt., p. cxxix.**
Compagnie Française du Télégraphe de Paris à New York, 34, Broad-st, 11, East 14th-st, 1, Mercers-st, and Pulitzer-bldg, New York.
Compañia Telegrafica-Telefonica de La Plata, Buenos Ayres
Electrofonia Franco-Argentina, Buenos Ayres
Metropolitan Telephone and Telegraph Company, 18, Cortlandt-st, New York
Mexican Telegraph Company, 37 and 39, Wall-st, New York
Postal Telegraph Cable Company, 250, Broadway, New York
River Plate Telegraph Company, Limited, Monte Video. (*See also* BRITISH DIVISION)
Société Française des Telegraphes Sous-Marins, Port-au-Prince, St. Marc, Gonaives, &c., Hayti (*See also* CONTINENTAL DIVISION)
WESTERN UNION TELEGRAPH COMPANY, 195, Broadway, New York. **See Advt., p. cxxx.**

TELEGRAPH ENGINEERS.

(Telegraph Superintendents, Managers, and Inspectors will be found on next page)

Brayshaw, James, Great Southern Railway Company, Buenos Ayres
Bury, Oliver Robert Hauke, Great Western Railway, Pernambuco, Brazil
Clipperton, Henry, Western and Brazilian Telegraph Company, Rio de Janeiro, Brazil

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Cross, A. Murray, Empresa del Telegrapho Submarino, Valparaiso, Chili
Green, Geo. A., Anglo-American Telegraph Company, Duxbury, Mass.
Howe, J., Brazilian Submarine Telegraph Company, Pernambuco
Oldham, John, Administrator Compañia Telegrafica del Rio de la Plata, Monte Video. Also Manager Western and Brazilian Telegraph Company at Monte Video
Raper, Chas. Hy., West Coast of America Telegraph Company, 49, Casilla Lima, Peru
Smith, J. E., 122, West 73rd-st, New York
Walker, F. Philip, Central and South American Telegraph Company, Casilla 729, Valparaiso

TELEGRAPH (&c.) SUPERINTENDENTS, MANAGERS, AND INSPECTORS (GOVERNMENT AND COMPANIES).

Austin, S. F., Compagnie Française du Telegraphe de Paris à New York, 34, Broad-st, New York
Betts, Walter, French Atlantic Cable Company, St. Pierre-Miquelon, Newfoundland
Brown, James, Direct United States Cable Company, 40, Broadway, New York
Carpenter, F. H., Western and Brazilian Telegraph Company, Maranham
Chaplin, W. B., Western and Brazilian Telegraph Company, Santa Catharina, Brazil
Clapperton, Geo., Commercial Cable Company, 1, Broad-st, New York
Davidson, C. I., Western and Brazilian Telegraph Company, Rio Grande do Sul, Brazil
Davis, T. H., Western and Brazilian Telegraph Company, Rio de Janeiro
Devereux, D. D., Western Union Telegraph Company, Duxbury, Mass. (Manager)
Eckert, Gen. Thomas T., President, Western Union Telegraph Company, 197, Broadway, New York
Fell, Otto, Western and Brazilian Telegraph Company, Pernambuco
Fraser, W. J., Direct United States Cable Company, Post Office-bldgs, Boston, Mass.
Hearn, R., Commercial Cable Company, Rockfort, Mass
Jordan, A., Western and Brazilian Telegraph Company, Para, Brazil
Kidd, A. E., Western and Brazilian Telegraph Company, Bahia, Brazil
Lanza, F. A., London Platino Brazilian Telegraph Company, Monte Video (Inspector-General)
Mardock, W. H., Western and Brazilian Telegraph Company, Ceara, Brazil
Moss, Geo. W., Mexican Telegraph Company, Vera Cruz, Mexico
Mountford, W. H., Anglo-American Telegraph Company, 8, Broad-st, New York
Needham, R. J., Anglo-American Telegraph Company, Duxbury, Mass.
Oldham, John, Western and Brazilian Telegraph Company, Limited, Monte Video
Porton, William, Santiago, Chili (Director-General of State Telegraphs)
Slater, Wm., Western and Brazilian and Brazilian Submarine Telegraph Companies, Buenos Ayres
Trippe, Chas., Anglo-American Telegraph Company, St. Pierre Miquelon, Newfoundland
Ward, G. G., Commercial Cable Company, 1, Broadway, New York (Vice-President and General Manager)

TELEPHONE APPARATUS, MAKERS OF.

Anglo-American Union, Limited, 136, Liberty-st, New York
Brown Dynamo Electric Telephone Company, Moline, Ill.
D'Unger Electrical Telephone Manufacturing Company, 167, Dearborn-st, Chicago, Ill.
Harrison International Telephone Company, Chicago, Ill.
Union Telephone Electric Manufacturing Co 64 & 66, Broadway, New York
Western Telephone Construction Company, 440, Monadnock-bldg, Chicago, Ill.

TELEPHONE COMPANIES.

Compañia Telegrafica-Telefonica de La Plata, Buenos Ayres
Compañia de Telefónos de Mexico, Mexico
Metropolitan Telephone and Telegraph Company, 18, Cortlandt-st, New York
Monte Video Telephone Company, Limited, Calle Rincon, Monte Video, South America. (*See also* BRITISH DIVISION)
United River Plate Telephone Company, Limited, 26, Calle St. Martin, Buenos Ayres. (*See also* BRITISH DIVISION)
West Coast Telephone Company, 13, Galeria San Carlos, Santiago

TELEPHONES, CONTRACTORS FOR THE ERECTION OF.

Brown Telephone and Telegraph Company of Chicago, 1225, Manhattan-bldg, Chicago, Ill.
D'Unger, P. H., 497, Brown-ave, Chicago, Ill.
Harbert (E. C.) & Co, 132, W. Van Buren-st, Chicago, Ill.
Harrison International Telephone Company, Chicago, Ill.
Interior Telephone Company, 203, Broadway, New York
Western Telephone Construction Company, 440, Monadnock-bldg, Chicago, Ill.

TRANSFORMERS, MAKERS OF.

Aloe—Aloe (A. S.) & Co, 425, North Broadway, St. Louis, Mo.
Brush—Brush Electric Company, Belden-st, near Masonst, Cleveland, Ohio
Cadmus Electric Manufacturing Company, Elkhart, Ind.
Diamond—Diamond Electric Manufacturing Company, Peoria, Ill.
Elkhart—Electric Appliance Company, 242, Madison-st, Chicago, Ill.
——— Electric Construction Company, Elkhart, Ind.
Hill Manufacturing Company, Salem, Va
Porcupine—Thwing Electric Company, Lake and Peoria-streets, Chicago, Ill.
Siemens & Halske—Siemens & Halske Electric Company, Manadnock-bldg, Chicago, Ill.

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Slattery—Fort Wayne Electric Company, Fort Wayne, Ind.
Stanley—Stanley Electric Manufacturing Company, Pittsfield, Mass.
Thomson-Houston—General Electric Company, 620, Atlantic-avenue, Boston, Mass., and Broad-st, New York
Westinghouse — Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

TURBINE MAKERS.

Chase—Chase Turbine Manufacturing Company, Orange, Mass.
Cramp & Co, Philadelphia, Pa.
Curtis—D'Este & Seeley Company, Boston, Mass.
Dow—Dow, J. H., Cleveland, O.
Dubuque Turbine and Roller Mill Company, Dubuque, Ia.
Hunt (Rodney) Machine Co, Orange, and 70, Kilby-st, Boston, Mass
Laidlaw-Gordon-Dunn Company, Cincinnati, O.
New American—Dayton Globe Iron Works Company, Dayton, O.
Pelton Water Wheel Company, 143, Liberty-st, New York, and Main-st, San Francisco, Cal.
Samson—Leffel (James) & Co, Springfield, O.; and 110, Liberty-st, New York
Swain Turbine Manufacturing Company, Lowell, Mass.
Victor—Stilwell-Bierce and Smith-Vaile Company, Dayton, Ohio, and at New York

VACUUM PUMPS, MAKERS OF.

Beacon Vacuum Pump and Incandescent Lamp Company, Irvington-st, Boston, Mass.
Packard—Hubbard, Norman, 93-97, Pearl-st, Brooklyn, N.Y.

VOLTMETERS, MAKERS OF.

Bristol's Manufacturing Co, Waterbury, Conn.; and 12, Liberty-st, New York
Brush Electric Company, Belden-st, near Mason-st, Cleveland, Ohio
Cutler—Cutter, Geo., The Rookery, Chicago, Ill.
General Electric Company, 620, Atlantic-ave, Boston, Mass.; and Edison-bldg, New York
Wagner-Queen—Queen & Co (Incorporated), 924, Chestnut-st, Philadelphia, Pa.
Weston Electrical Instrument Company, 114-120, William-st, Newark, N.J.

VULCABESTON (for Electric Insulation, Magnet Spools, Commutator Rings, Bushings, &c.; Steam Packings, Washers, Caskets, &c.)

H. W. JOHNS MANUFACTURING CO, 87, Maiden-lane, New York City, U.S.A.

WALL SOCKETS, MAKERS OF.

Ries Electric Speciality Company (Incorporated), 7, South Gay-st, Baltimore, Md.

WIRE COVERERS.

Clark, E. W., 31, Wells-st, Hartford, Conn.
Okonite Company, Limited, 13, Park-row, New York, and Passaic, N.J. (*See also* BRITISH DIVISION)
Robertson's Lead Incasing Works, 131, Water-st, Brooklyn, N. Y.

WIRE MANUFACTURERS.

Aluminum Brass and Bronze Company, Bridgeport, Conn. (Silicon Bronze Wire)
American Electrical Works, Providence, R.I.; and 10, Cortlandt-st, New York (Insulated Wire)
Benedict and Burnham Manufacturing Company, Waterbury, Conn.
Bishop Gutta Percha Company, 420-426, East 25th-st, New York. (Insulated Wire)
Boston Electric Wire Company, Allston, Mass.
Bridgeport Brass Company, Bare and Insulated Wire for Electric Conductors, Bridgeport, Conn.
Brixey, W. R., 203, Broadway, New York; and Chicago, Ill.; works: Seymour, Conn. (Insulated Wires and Cables)
Bruce & Cook, 190, Water-st, New York
Chicago Insulated Wire Company, 207, South Canal-st, Chicago, and (Factory) Sycamore, Ill.
Clarke, C. A., 146, Franklin-st, Boston, Mass.
Cushing & Morse, 225, Dearborn-st, Chicago, Ill.
Eastern Electric Cable Company, 61-65, Hampshire-st, Boston, Mass.
Fottrell Insulated Wire Company, Philadelphia, Pa.
India Rubber and Gutta Percha Insulating Company, 315, Madison-avenue, New York. (Insulated Wires and Cables)
Lewishon Bros, 81, Fulton-st, New York
McIntire Manufacturing Company, 13-15, Franklin-st, Newark, N.J.
Moore, A. F., 200, North Third-st, Philadelphia, Pa. (Insulated Wire)
New Haven Insulated Wire Company, Haven and Market-sts, New Haven, Conn.
New York Insulated Wire Company, 13-17, Cortlandt-st, New York; and Chicago Ill.
Norwich Insulated Wire Company, 44, Broad-st, New York, and Harrison, N.J.
Okonite Company, Limited, 13, Park-row, New York; and Passaic, N.J.
Phillips (Eugene F.) Electrical Works, Limited, Providence, R.I.
Phillips Insulated Wire Company, Pawtucket, R.I.; and 39-41, Cortlandt-st, New York
Roebling's (J. A.) Sons & Co, Trenton, N.J.; 171 and 173, Lake-st, Chicago, Ill.; and at New York, and San Francisco, Cal.
Safety Insulated Wire and Cable Company, 234, West 29th-st, New York. (Insulated Wire)
Simplex Electrical Company, 620, Atlantic-avenue, Boston, Mass. (Simplex Wire)
Standard Underground Cable Company, Westinghouse-bldg, Pittsburg, Pa. (Insulated Wires)
Tatham & Bros, 226, South Fifth-st, Philadelphia, Pa.
Washburn and Moen Manufacturing Company, Worcester, Mass.
Western Electric Company, 227, South Clinton-st, Chicago, Ill.; and at New York

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BIOGRAPHICAL NOTICES.

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Yours faithfully
Alex Stevens

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Alex Siemens

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"THE ELECTRICIAN"

ELECTRICAL TRADES' DIRECTORY

AND HANDBOOK, 1894.

BIOGRAPHICAL SECTION.

(*Specially prepared for this* DIRECTORY AND HANDBOOK.)

ABDANK-ABAKANOWICZ, Bruno. Born in Wilkomir (Poland), 1852.

Mr. Abdank-Abakanowicz was educated at the Riga Polytechnicum, and graduated in 1873. From 1874 he occupied the chair of Graphical Statics and Applied Mechanics at the Polytechnic School at Lemberg (Austria) until 1881, when he went to Paris and established himself there as a consulting engineer. He is the author of a treatise on "Graphical Statics" (Lemberg, 1876), "Integrating Machines" (1881). In 1886 he published a book on new integrating machines of his invention (Les Integraphes), and in the year 1890 he published a book in German on integrating apparatus. He is the author of many Papers that have appeared in the *Comptes Rendus* of the Academy of Sciences, in Paris, and in various translations. He is a member of the Société de Physique and of the Council of the Société Internationale des Électriciens. In 1889 he organised the United States section of the Exhibition at Paris, and was nominated member of the Jury. He is a Knight of the Legion of Honour.

ABEL, Sir Frederick Augustus, Bart., K.C.B., D.C.L. (Oxon.), D.Sc. (Cant.), F.R.S. Born in 1827.

Sir F. A. Abel was Demonstrator of Chemistry at St. Bartholomew's Hospital in 1852, Professor of Chemistry at the Royal Military Academy (in succession to Prof. Faraday), Chemist of the War Department from 1854, President of the Government Commission on Explosives 1888-91, a member of the Royal Engineers' Committee, and associate member of the Ordnance Committee. He retired in 1891 from Government service. He is Past-President of the Institute of Chemistry, of the Society of Chemical Industry, of the Chemical Society, of the Institution of Electrical Engineers, of the British Association, of the Iron and Steel Institute, and Chairman of Council of the Society of Arts. He is Royal Medallist for researches in explosives, was a member of the Royal Commissions on Accidents in Mines, on Noxious Vapours, &c., hon. member of the Institute of Civil and Mechanical Engineers, of the Royal United Service Institution, and of the German Chemical Society, Telford Medallist, and Albert Medallist. He was created C.B. in 1877, was Commissioner to the Electrical Exhibition at Vienna in 1883, was knighted in that year, created K.C.B. early in 1891, and made a baronet in 1893. He was Bakerian Lecturer in 1867, and Rede Lecturer in 1888. He is secretary and director of the Imperial Institute, Warden of the Goldsmiths' Company, and member of the Royal Commission for the Chicago Exhibition.

ADAMS, Prof. W. Grylls, M.A., D.Sc., F.R.S., Past-President S.T.E. and E. Born in 1836.

In 1855 Mr. Adams entered at St. John's College, Cambridge, and took high honours in the Mathematical Tripos in 1859. He was elected a Fellow of St. John's College, and for four years in succession was appointed Examiner in Physics for the Natural Science Tripos. Prof. Adams was again appointed Examiner in Physics in the University of Cambridge for the year 1887-88, and was re-elected for the following year. For two periods of five years each he has been Examiner in Experimental Physics in the University of London, and is one of the representatives of that University on the Board, and is a member of the Council for the Extension of University Teaching in London. In 1864 he assisted Prof. Maxwell in his celebrated experiments at King's College to determine the value of the ohm. In 1865 Prof. Adams was appointed Professor of Natural Philosophy in King's College, as successor to the late Prof. Maxwell. The Physical Laboratory, under the charge of Prof. Adams, was established in the year 1868 for practical study and research in all

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branches of experimental physics. Prof. Adams is a Fellow of the Royal Society, a Past-President of the Society of Telegraph-Engineers and Electricians, and a Past-President of the Physical Society of London. In the spring of 1881 he gave a course of Cantor Lectures at the Society of Arts on "The Scientific Principles involved in Electric Lighting," in which he treated the subjects of electrical measurement, the efficiency of dynamo machines, and arc and incandescent lighting. He was on the Jury of the Crystal Palace Electrical Exhibition in 1882, was also a member of the International Congress of Electricians at Paris in 1881, and chairman of the Lightning Rod Conference, which published a report on the subject in 1882. Prof. Adams has written Papers on "Magnetic Disturbances and Earth Currents," published in Report of British Association, 1881; also on "Equipotential Surfaces"; and on "The Action of Light on Selenium," which have been published in the *Proceedings* and in the *Transactions* of the Royal Society. In his address as President of the Mathematical and Physical Section of the British Association at Swansea in 1880, Prof. Adams gave an account of recent investigations by M. Pictet and others in the "border land" between chemistry and physics. He reviewed the recent progress in spectrum analysis, and drew attention to the magnetic change and disturbances on the earth as in a great measure due to the action of the sun. In 1881 he communicated to the British Association a report on the comparison of Magnetic Disturbances at the different Observatories, and still more recently has been carrying on investigation, on this subject, which have been published in the *Philosophical Transactions* of the Royal Society. In 1885 he reported on the South Foreland experiments on Lighthouse Illuminants, and gave some of the results of his investigations to the British Association at Aberdeen in his lecture on "The Electric Light and Atmospheric Absorption." In December, 1888, Prof. Adams was created Doctor of Science in the University of Cambridge.

ALBRIGHT, J. F., C.E., M.E., E.E. Born in Birmingham, 1857; educated at a private school at Tottenham; matriculated at the London University in 1874; was for nearly two years at the Crystal Palace Engineering School; about three years with Sir J. Bazalgette as a pupil on various works; and afterwards, in the employment of the Metropolitan Board of Works, on the new Storm Overflow Works.

In the summer of 1880 Mr. Albright joined the Swan Company in Newcastle, and at once commenced work on the "Servia." He afterwards took charge of the Company's Crystal Palace exhibit, and did various other work till the amalgamation took place with the Edison Company, when he was instructed to superintend all the ship-lighting work of the joint companies. Shortly after the beginning of 1883 he was appointed Resident Engineer in charge of all the work of the Edison-Swan Company, except the land work carried out in the North, which was then superintended by Mr. J. W. Edmundson. Before long Mr. Albright took entire charge of all contract work for the above company, and continued to do so until the spring of 1884, when he left the Edison-Swan Company to go into partnership in the firm of R. E. Crompton and Co. (now Crompton and Co., Limited), of which he is Managing Director. He is also Chairman of the Crompton-Howell Electrical Storage Company, and a Director of the Crompton Electric Supply Company of Australia, of the Birmingham Electric Supply Company.

ANDERSEN, F. V. Born July 10, 1852.

Mr. Andersen, in 1870, entered the service of the Danish Government Telegraphs, from 1872 to 1882 residing in Copenhagen. While in the telegraph service he kept a school in electrotechnics and languages for aspirants to appointment in the service. During this period he made his first essay as an inventor; he devised a Gramme machine, but found, on trying to put the same into practice, that he had been anticipated. He joined an instrument-maker, whom he supplied with several successful designs in telephones, electric clocks, &c. After having seen the Electrical Exhibition in Paris, Mr. Andersen obtained employment with the Electrical Power Storage Company, in London. During the latter part of his stay with this firm he was in charge of the laboratory, and through a series of careful experiments helped to establish the now well-known rules for the best practical working of secondary batteries. He proved in 1884 the important fact which recently has been pointed out by Prof. Ayrton, that the action in the cell as constructed in the ordinary manner —with connections at the top of both sets of plates—is stronger near the top than at the bottom, and he devised a cell with bottom connections to the spongy plates in which this defect was remedied. His experiments on this cell showed that the same number of plates have, when used in this manner, 15 per cent. more capacity than when worked in the ordinary way. While with the Electrical Power Storage Company he made a most careful study of the dynamo-machine, which in their factory was represented almost in all its important types, and worked out a set of empirical formulæ by means of which he has been able to calculate with great exactness dynamos in all sizes. At that time (1883) he devised the first electro-magnetic cut-out, the automatic charging-switch, and various other apparatus. At the end of 1884 he joined Messrs. Latimer Clark, Muirhead and Co. with a view to devoting himself to dynamo work and the electric light generally. With this firm he designed the "Westminster" dynamo, of which type a great many excellent machines are now working, and brought out improvements in arc lamps, ships' telegraphs, &c. In the beginning of 1888 he devised the special system of electric light distribution which is known under the term "distribution by a ring-main," and which at the same time was introduced in Germany by Mr. Fritsche. The system was

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WILLIAM THOMAS ANSELL.

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specially designed by Mr. Andersen for the St. James's district, and he devised a new form of iron culvert to meet the many difficulties which in this district presented themselves against an underground system of heavy mains. Mr. Andersen won, in connection with a friend, the prize for the best design of an electro-motor in the competition opened by *Industries* in 1886. He now practises as a consulting electrical engineer and electrician.

ANDREWS, J. D. F., M.I.E.E., A.M.I.C.E.

After an early education in Germany, during the period of the Franco-German War, Mr. Andrews started his business career in the publishing office of Messrs. Smith, Elder and Co.; but this class of occupation not conforming with his mechanical tendencies, he solicited the favour of Sir William Siemens, by whose kindness he was placed in the works at Charlton as pupil, and obtained an excellent insight into the various departments, extending over five years. At the expiration of this period Mr. Andrews took charge of the electric-light department of Messrs. Latimer Clark, Muirhead and Co., where he remained until he was induced to undertake the management of a new company in Scotland. The life of this company was not long, and Mr. Andrews started the firm of J. D. F. Andrews and Co., which he carried on at Woodside Electric Works for over five years, after which the business merged into that of Messrs. Muir, Mavor and Coulson, in which firm Mr. Andrews became a partner. During this period the central supply stations in Glasgow were established by the firm, who later on sold this part of their business to the Corporation of Glasgow when the firm dissolved partnership, and Mr. Andrews returned to London. Here he opened up business again as J. D. F. Andrews and Co., and has since continued. Mr. Andrews has made many inventions that have established his reputation in the electrical world. Those that have received most extended adoption are his dynamo, which is of the four-pole type, having a ring armature, the coils of which are connected in series in such a way that only two collecting brushes are required. Mr. Andrews' arc lamp is well known, also his switches, regulators, and various accessories of electric light installations, which have been adopted both in land and ship installations to a large extent. The most important of Mr. Andrew's inventions, however, is the system of concentric wiring, in which the outer conductor is entirely bare. This system he has perfected in every detail, and he has overcome the prejudice that very strongly existed to the use of a bare conductor, both in the minds of the general public and especially with some of the insurance companies. The system has marked features of advantage, and is rapidly extending in all classes of installations.

ANSELL, William Thomas, F.R.G.S., M.I.E.E. Son of Dr. Ansell; born in London, November, 1822; educated at Bruce Castle, Tottenham, &c., and at Paris.

After spending some years on his paternal estate in Berbice, West Indies, Mr. Ansell, on his return to England in 1845, joined the service of the Electric Telegraph Company, prior to its incorporation in March, 1846, under the auspices of the late John Lewis Ricardo, M.P. Mr. Ansell remained in the service of this parent and pioneer company as District Superintendent and Engineer, and, finally, as General Superintendent, till its transfer to the Government in 1870. In consequence, however, of impaired health, through the severity of his duties as General Superintendent, he obtained leave of absence from 1858 to 1861; but the energy which had characterised his official career was ill-suited to an idle life, and quickly utilising the opportunity thus afforded him, he accepted temporary service in the Levant and in Turkey, under Messrs. Newall and Co. On his return to England Mr. Ansell was appointed General Superintendent and Engineer in Ireland for the Electric and International Telegraph Company. On the transfer of the telegraphs to the State, in 1870, Mr. Ansell, accepting a pension, transferred his services to the Eastern Telegraph Company and associated companies as Traffic Superintendent. It has been his good fortune during his career to be always in the vanguard of those employed in extending and organising the telegraphic system, and no man is, perhaps, better known and esteemed throughout the length and breadth of the land than the subject of this brief notice. Mr. Ansell is a Fellow of the Royal Geographical Society, and a Member (and ex-Member of the Council) of the Institution of Electrical Engineers.

ARRHENIUS, Svante August, Ph.D., Stockholm. Born near Upsala (Sweden), in 1859, and educated at the Gymnasium and University, Upsala; became Philosophical Doctor and Instructor at this University in 1884, and Teacher of Physics at the University of Stockholm in 1891.

From 1881-85 he worked experimentally at the Physical Institute of the Academy of Science, in Stockholm, under Prof. Edlund, and afterwards was sent out by this Academy to study experimental physics and physical chemistry at foreign institutes. It was then that he attended (1886-88) the laboratory for physical chemistry of Prof. Ostwald in Riga (afterwards in Leipsic), the physical institutes of Prof. Kohlrausch in Wurzburg, Prof. Boltzmann in Graz, and the laboratory for physical chemistry of Prof. van 't Hoff in Amsterdam. Once more, in 1889 and 1890 we find him at the universities of Leipsic and Graz. His researches, which have been published in several languages (Swedish, German, English, French, Dutch, and Russian), relate mostly to the electric conductivity of electrolytic solutions and their qualities. To explain these he established the theory of electrolytic dissociation, according to which the various salts in very diluted solutions dissociate into their electrolytic elements. As an example, it may be mentioned that NaCl in 1 per cent. solution gets dissociated into Na and Cl at a rate of about 90 per cent. His other researches refer to the conductivity of gases and the

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phenomena of atmospheric electricity. In 1891 he proved that the vapour of salts, brought into a Bunsen flame, conducts electricity in the same way as do electrolytes.

ATKINSON, Llewelyn Birchall, A.K.C., A.M.I.C.E. Born at Builth, Breconshire, in 1863. Educated at Merchant Taylors' School and King's College, London.

Mr. Atkinson was first educated at Merchant Taylors' School, where his scientific knowledge was gained in the classes and laboratories set apart for the study of chemistry, physics, and geology. He also attended the evening classes then just commencing under Prof. Ayrton at the Finsbury Schools, which have since developed into the Finsbury Technical College, and in 1881 obtained the Silver Medal in honours, at the first examination held by the City Guilds on Electric Lighting and Power Transmission. After leaving Merchant Taylors' School he entered the Department of Applied Sciences at King's College, London, where in the first year he was awarded the Sambroke exhibition, and in the second and third year the Jelf Medal, awarded to the student of either year who most distinguished himself. After leaving King's College, of which he was elected an associate, he entered the works of Messrs. Kitson and Co., Airedale Foundry, Leeds, and there gained a thorough knowledge of the details of a large engineering works. In 1884 he entered the Halifax works of Messrs. W. T. Goolden and Co. (then Goolden and Trotter) as a pupil, and afterwards with them was engaged as an engineer, and later on joined the firm as a partner. He has taken (in conjunction with his brother, Mr. C. W. Atkinson) a very prominent part in the introduction of electrical power to mining operations, more particularly in coal mining, and is the inventor and patentee of a great variety of appliances and methods of construction in connection with electric mining machinery. He is also the inventor and patentee of many other electrical contrivances and arrangements, including the production and application of alternating currents for motive power. He was entered as a student of the Institution of Civil Engineers in 1883, and whilst a student was awarded a Miller Prize for a Paper on "Electrical Measuring Instruments," in which was published for the first time a method of measuring the power in an alternating circuit, by means of two quadrant electrometers, with the needles mechanically connected. In 1890-1 he was the joint author (with his brother, Mr. C. W. Atkinson) of a Paper read before the Institution of Civil Engineers, upon Electric Mining Machinery, for which two Telford Medals and premiums were awarded to the authors. This Paper has been republished in America, France and Belgium. He is also joint author with his brother of a Paper read before the Mining Institution of Scotland, on the "Applications of Electricity to Mining," as also of a Paper on a similar subject read before the Staffordshire Institute of Mining Engineers. Mr. Atkinson is a member of the North of England Institute of Mining and Mechanical Engineers.

AYLMER, John. Born in Bath on July 24th, 1841; educated by private tuition, afterwards at Carnarvon, and at the Ruabon Grammar School, under the Rev. A. L. Taylor.

In 1859 Mr. Aylmer entered the chemical laboratory of the late Mr. Dugald Campbell, in Chancery-lane, where he worked at practical chemical analysis for a couple of years, and then joined the firm of Messrs. Siemens Brothers at that time Siemens and Halske), where he was associated with the late Mr. Schwendler and the late Mr. R. Sabine in electrical testing and in carrying on telegraphic work. He was sent abroad as representative of the firm, and was for some years engaged in erecting telegraph lines, chiefly in Spain, and assisting in submarine cable-laying expeditions. In 1871 Mr. Aylmer fixed himself in Paris, practising on his own account as an electrical engineer, and became the foreign agent of the late Sir Charles Wheatstone. It was through his efforts, and under his immediate superintendence, that the Wheatstone fast-speed automatic telegraph was established on the chief French lines. He also put this system to work on the Italian, Russian, and Spanish lines. When the great Electrical Exhibition held in Paris in 1881 was being prepared, Mr. Aylmer took in hand the organisation of the British section; and it was in consequence of his personal efforts that our chief electrical inventors and manufacturers were induced to exhibit. When, later on, the British Government named a commission to carry on the section, Mr. Aylmer was appointed the hon. secretary, and continued the work he had so well begun. At the close of that Exhibition the French Government showed its appreciation of his services in connection with it by bestowing upon him the decoration of Chevalier of the Legion of Honour. In 1881 the King of Spain created him a Knight Commander of the Royal Order of Isabel la Catolica, in recognition of his services to the Government of that country; and in 1883 the British Government appointed him as one of the English representatives at the International Congress that met in Paris and fixed the standard electrical units that are now universally used. When preparations were being made in this country for its participation in the great Universal Exhibition held in Paris in 1889, Mr. Aylmer took an active part in the organisation of the British section; and, in 1888, the executive committee formed at the Mansion House, under the presidency of the Lord Mayor, to work that section, appointed him their honorary local secretary in Paris. Mr. Aylmer was named one of the two English members of the jury for Class 62 (Electricity) at this Exhibition; and at its close the French Government bestowed upon him the decoration of Officer of the Legion of Honour in recognition of his services. At the Paris meeting (1890) of the International Telegraphic Conference Mr. Aylmer represented the Colonies of New Zealand and New South Wales. He has acted as hon. local secretary and treasurer in France to the Institution of Electrical Engineers since its formation as the Society of Telegraph Engineers and Electricians. He is a member of the Council of the Société Internationale des Electriciens.

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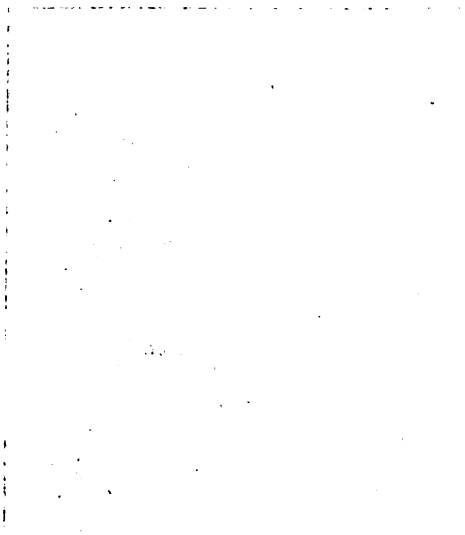

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W. E. AYRTON.

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AYRTON, Prof. W. E., F.R.S. Educated at University College School, where he gained numerous prizes, and entering subsequently into the College, gained the Andrews Exhibition in 1865 and the Andrews Scholarship in 1866.

Passing the examination with honours for his first B.A. in 1867, Mr. Ayrton in the same year came out first in the Entrance Examination for the Indian Government Telegraph Service. He was then sent by the Secretary of State for India to study electrical engineering with Prof. Sir William Thomson, coming out first at the Advanced Examination for the Indian Government Telegraph Service, and won the Scholarship. When in India Prof. Ayrton acted first as the Assistant Electrical Superintendent, and subsequently as the Electrical Superintendent in the Government Telegraph Department, introducing, with the late Mr. Schwendler, throughout British India, a complete system of immediately determining the position of a fault in the longest telegraph line by electrically testing at one end. In 1872-3 Prof. Ayrton was on special duty in England on behalf of the Indian Government Telegraph Department, and in charge of the Great Western Telegraph Manufactory in London, on behalf of the engineers, Prof. Sir William Thomson and the late Prof. Fleeming Jenkin. From the latter year until 1879 Prof. Ayrton was the Professor of Natural Philosophy and of Telegraphy at the Imperial College of Engineering, Japan, the largest English-speaking Technical University in existence at that date. In 1879 he was appointed Professor of Applied Physics at the City and Guilds of London Technical College, Finsbury, and in 1884 the Chief Professor of Physics at the Central Institution, South Kensington, of the City and Guilds of London Institute; in 1880 a Secretary of the Mathematical and Physical Section of the British Association; and in 1881 was elected a Fellow of the Royal Society.

Prof. Ayrton is a Past President of the Physical Society and of the Institution of Electrical Engineers, and is a Member of Council of the British Association, a Governor of the Imperial Institute, and a Member of the Council of Almoners of Christ's Hospital; he has been a Juror in the majority of the Electrical Exhibitions in England and abroad, was one of the English Government delegates to the Electrical Congress at Chicago, and is joint editor of Cassell's "Manuals of Technology," and the author of "Practical Electricity," the most recently-published work in this series, but already in its seventh edition. His lecture on the "Electric Transmission of Power," given at the meeting of the British Association at Bath, in 1888, was so much appreciated that, at the request of the town, this lecture was repeated to an audience of 3,000, the first time in the annals of the British Association that one of their lectures has been repeated. With Prof. Perry he is the joint inventor of the well-known ammeters, voltmeters, electric power meter, ohmmeter, dispersion photometer, transmission dynamometer, dynamometer coupling, governed electric motor, oblique coiled dynamo machine, and secohmmeter; and, with the late Prof. Fleeming Jenkin and Prof. Perry, of the system of automatic electric transport known as "Telpherage."

About one hundred Papers which have been published in the *Proceedings and Transactions* of the Royal Society, Physical Society, Society of Telegraph Engineers, and other societies have been contributed by Prof. Ayrton conjointly with Prof. Perry and others, of which some of the most important are: "The Specific Inductive Capacity of Gases"; "The Contact Theory of Voltaic Action"; "A New Determination of the Ratio of the Electromagnet to the Electrostatic Unit of Quantity"; "A Duplex Partial Earth Test"; "Electricity as a Motive Power"; "Experiments on the Heat Conduction of Stone"; "On a Neglected Principle that may be Employed in Earthquake Measurements"; "The Magic Mirror of Japan"; "Electric Railways"; "Measuring Instruments used in Electric Lighting and Transmission of Power"; "Economic Use of Gas Engines"; "Electromotors and their Government"; "A New Form of Spring for Electric and other Measuring Instruments"; "The Gas Engine Indicator Diagram"; "The Most Economical Potential Difference to use with Incandescent Lamps"; "The Winding of Voltmeters"; "Economy in Electrical Conductors"; "Uniform Distribution of Power from an Electrical Conductor"; "Modes of Measuring the Coefficients of Self and Mutual Induction"; "The Driving of Dynamos with very Short Belts"; "Portable Voltmeters for Measuring Alternate or Direct Potential Differences"; "The Magnetic Circuit in the Dynamo"; "The Efficiency of Incandescent Lamps with Direct and Alternate Currents"; "Galvanometers"; "Interference with Alternate Currents"; "Measurement of the Power given by any Current to any Circuit"; "Quadrant Electrometers"; "The Thermal Emissivity of Thin Wires"; "The Efficiency of Transformers, and the Regulation of Transformers at Different Frequencies." Prof. Ayrton, with Prof. Perry, has also taken out twenty-six patents in Great Britain, several of them also in France, Germany, America, and other foreign countries; and he is also co-patentee with Mr. Mather of various electrical measuring instruments.

BADT, Lieut. Francis B. Born Oct. 4, 1849.

In 1869 Lieut. Badt joined the Prussian artillery. During the Franco-Prussian War of 1870-71 he was Second Lieutenant in the Eleventh Regiment of Field Artillery attached to the army of Crown Prince Frederick William, the late Emperor Frederick III. He took part in twenty-two battles and assaults, among them the battle of Sedan and the siege of Paris. He was decorated for bravery with the iron cross and a campaign medal. He left the service in 1881 and went to the United States. In January of the following year he entered the service of the United States Electric Lighting Company, and in the spring went to Chicago as representative of the Company. In 1888 he was transferred to the New York office of

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the Company, and during the summer was sent as its representative to Europe, on a confidential mission. After travelling in Europe for six months, he returned and joined the Western Electric Company. He remained with this corporation until he received the appointment of Superintendent of the Engineering Department of the Edison Company. On Nov. 1, 1890, Lieutenant Badt resigned his position with the Edison Company, and accepted the position of Manager of the Western Power and Mining Department of the Thomson-Houston Electric Company (now, with the Edison Company, forming the General Electric Company). During the last four years Lieutenant Badt has written several popular handbooks on electrical subjects. They are: "Dynamo Tenders' Handbook" (a new edition of which he has published), "Bell-Hangers' Handbook," "Incandescent Wiring Handbook," "Derivation of Practical Electrical Units," and "Electric Transmission Handbook." Lieutenant Badt is First Vice-President of the Chicago Electric Club. He was Consulting Electrical Engineer to the World's Columbian Exposition.

BAILEY, J. Born in London, July 24th, 1830; and at the age of fourteen obtained a situation in a mercantile office, where he remained for some years.

In 1848 Mr. Bailey entered the service of Messrs. Silver and Co., and was eventually appointed resident manager of the Silvertown Works, which at that time gave no promise of their present importance. During the length of time—more than 30 years—that Mr. Bailey has continued to manage at Silvertown his arduous duties have left him no leisure for literary work; we are glad to think, however, that he has contributed in a great measure to the success enjoyed by his firm.

BANDSEPT, A., A.M., C.E. Born at Strasburg, June 18, 1846; was educated at the higher Government Schools.

M. Bandsept is a member of the Société de Physique, and of other learned bodies. He is the delegate for Belgium of the Société Internationale des Électriciens, and is a member of the Committee of the Belgian Society of Engineers and Industrials.

M. Bandsept from time to time contributes to *The Electrician* valuable articles upon electrical science. He is also a frequent contributor to some French and Belgian periodicals. He has devoted considerable time and no little ability to the study of accumulators and the improvement of the incandescent light. Amongst other improvements in primary batteries, and especially in accumulators, M. Bandsept turned special attention to the means of recovering the work hitherto lost in secondary actions of electrolysis. He undertook a series of experiments to determine the molecular structure for electrodes which shall most assist the condensation effects to which elements dissociated by electricity are subject, and was thus led to construct his electrodes of finely-divided materials, compressed while being saturated with gaseous substances. While engaged in these researches M. Bandsept made several interesting scientific discoveries. He found, for instance, that in electrolytic action the state or nature of electrodes produced a kind of selection upon the radicals freed at their surface; so that bubbles are smaller and rise the more rapidly the finer the constituents of these electrodes. In taking very finely divided and pure carbon, direct reaction may occur between C and O, so that a chemical phenomenon is substituted for the physical one, by the only means of material division. Other mathematical investigations upon electric conduction led him to definite conductivity as an immediate consequence of atomic induction, and the conductor as a core of disturbance introduced in the field of force, being the path upon which the lines are directed. In fact, M. Bandsept denies that electric transmission is done by the ether, outside of the wire. His conclusions are that electricity is retained at the surface, and that the mechanism of propagation may be explained by reaction between the elements of the field and the intermolecular matter of the molecules at the surface of the wire. The demonstration proceeds from several abstract considerations on the constitution of matter in motion, articles on which have recently appeared. He has also devised several new combinations for primary and secondary batteries.

M. Bandsept has also employed with success his method of pulverisation for rendering materials fireproof, and for other industrial purposes. This method of mechanical pulverisation, first employed in the endeavour to modify the physical properties of bodies, led him to some remarkable experiments regarding the transmutation of metals. Articles to be coated are subjected to a jet of intense heat, whilst the impregnating substances are projected with great force on the heated surface. The principles of this transmutation are—rapid heating, so as to dilate only the uppermost atomic layers, and the sudden cooling which naturally ensues. The operation, therefore, results from two combined effects—molecular adherence (of the coating), and superficial tempering. In certain cases the latter effect may only result, and a direct exterior tempering be obtained, whilst the inner part of the metal is not affected. Very intense heat being required for such operations, M. Bandsept was led to interesting investigations upon flames obtained from gas previously and thoroughly mixed with the exact proportion of air or oxygen necessary to realise the conditions of the highest combustion By means of mechanical trituration, the gases are so diffused that they exist as a permanent mixture, somewhat like that obtained by suddenly cooling the elements of partial dissociation, even after combination has been effected. The previous mixture is so perfect and gives out such complete combustion, with such regular and continuous effect, that burners can be immersed in water, thus giving the least output by heating or evaporating. This rational system of combustion may be applied to different treatment; in fact, it reverses the ordinary condition of ebullition. M. Bandsept is a great student of molecular mechanics, which he considers will be the

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mechanics of the future. M. Bandsept was appointed chief engineer of the Electrical Department International Brussels Exhibition, 1888 (Grand Concours), where he had the management of the whole installation, comprising 450 arc lamps and several hundreds of incandescent lamps. He contributed to make the electric lighting one of the principal, if not the chief, attraction of the Brussels Exhibition. He also had charge of the gas lighting, and constructed a new kind of intensive lamp, which obtained at the Paris Exhibition of 1889 a gold medal, the highest award given in Class 27. M. Bandsept is consulting engineer to several firms in Brussels making a speciality of experiments in lighting and heating and the manufacture of appliances therefor.

BAUR, Dr. C. Born in 1857 at Zürich, and educated at the Federal Polytechnikum.

Dr. Baur graduated in 1879 as Doctor of Philosophy in the University of Zürich, having written a Paper on the Magnetisation of Iron, which dealt with the magnetisation produced by very small forces, and on the influence of temperature on the permeability—some fundamental laws being established for the first time. In 1881-2 he continued his studies at the University of Berlin in Prof. Helmholtz's physical laboratory, where he brought out the "bolometer," simultaneously with Prof. Langley in America. This instrument is now in extensive use on the Continent for measuring radiant heat, replacing for that purpose the thermopile. In 1882 and 1883 he published two Papers on this instrument, and its application to the measurement of rock salt radiation. Dr. Baur has since occupied different positions, and has published some minor Papers, amongst them in 1886 a description of a new automatic temperature regulator. He is a Member of the Institution of Electrical Engineers.

BEDELL, Frederick, Ph.D. Born in Brooklyn, N.Y., U.S.A., 1868; educated at Montclair High School, Yale University and Cornell University.

Mr. Bedell pursued the regular classical or arts course in Yale College, where he was the recipient of various prizes and honors, particularly in mathematics and the natural sciences, although he attained distinction in other lines as well, and at the completion of his course stood third in his class in general scholarship. He graduated in 1890 as Bachelor of Arts with high honors, being one of three to receive the appointment for a Philosophical Oration. His university education was obtained at Cornell University, where he was appointed Fellow in Electrical Engineering for 1891-92 by a unanimous vote of the faculty. He received the degree of Doctor of Philosophy from Cornell University in 1892, was then appointed instructor in the Department of Physics under Dr. E. L. Nichols, and in 1893 was appointed Assistant-Professor of Physics in the same place. Dr. Bedell is a member of the Honorary Literary Society of Phi Beta Kappa, the Honorary Scientific Society of Sigma Xi, and of Alpha Delta Phi; also of the American Association for the Advancement of Science, American Society of Mechanical Engineers, and of the American Institute of Electrical Engineers. His writings, which have appeared in various scientific and engineering journals and in the *Transactions* of societies, have been widely copied and translated. Much of his work has been in conjunction with Dr. A. C. Crehore, with whom he published, in 1892, the treatise entitled "Alternating Currents: An Analytical and Graphical Treatment for Students and Engineers." The work was well received, and was immediately adopted as a text-book in many technical schools; a second edition was brought out early in 1893. Dr. Bedell is continuing his scientific work at Cornell.

BELL, Alexander Graham, was born at Edinburgh, Scotland, March 3, 1847.

Prof. Bell's father and grandfather were both teachers of languages, &c.; and his father early gave him instruction in the anatomy of the vocal organs, their various functions, and the different subjects belonging generally to the science of vocal physiology. When quite a child, A. G. Bell was told by his father of an automaton speaking-machine he had seen; and the boy was so interested that he determined to attempt the construction of such an apparatus himself, and he then and there invented a speaking-machine, built it, and made it articulate one or two simple words. While at Elgin, in Scotland, he found out for himself, also, that the elements of speech were compound in their nature, and became interested in the important work done by Helmholtz, relating to the quality of vocal sounds. In 1865, the family removed from Scotland to London; and about 1866, at Bath, in England, he conceived the idea of following up Helmholtz's synthetical experiments in the reproduction of sound, by attempting to transmit speech electrically. Between the years 1867 and 1870, he made numerous electrical inventions based on the Helmholtz vowel apparatus, and, before he left England, had resolved to pursue one of these inventions, that of harmonic or multiple telegraphy, to a practical outcome. The idea of actual speech-transmission was running in his mind all this time, like an undercurrent of thought that he could hardly formulate in definite expression; but it gradually took clearer shape, and Mr. Bell has stated on the witness stand that to friends in England, before 1870, he avowed his belief that we should "one day speak by telegraph." In August, 1870, the Bell family emigrated from England to Brantford, Canada; and in April, 1871, A. G. Bell went thence to Boston, on the invitation of the Boston School Board, to carry on a series of experiments with his father's system of "visible speech, or physiological symbols for the deaf." He remained permanently in the neighbourhood of Boston, from October 1, 1872, until his removal to Washington, in 1881. From the very moment of his arrival in Canada, in 1870, up to the beginning of 1874, his mind was full of the

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scheme for the multiple transmission of telegraphic messages by means of musical tones, and he had other telegraphic inventions also in hand; but the old idea of speech-transmission was persistent in claiming his attention, and gradually his thoughts and energies were narrowed down to this one field of investigation. He has himself narrated more than once the manner in which he proceeded, stage by stage, from his experiments with phonautographic apparatus, human ear-drums, and apparatus for obtaining undulatory currents, up to the period when he and his assistant, Mr. T. A. Watson, were able to talk to each other telephonically over a short line in the Boston University, and when by rapid strides the crude apparatus was improved and brought up to a fair degree of efficiency. The first tests with the telephone as a speech-transmitter were watched with great interest by many scientific men, to whom Bell communicated his results freely, and from whom he received many valuable suggestions; but the press and public were sceptical in regard to the reports that began to circulate. Bell's first public lecture on the telephone was delivered before the Society of Arts, Boston, May 25, 1876; but the first time that speech was transmitted over a real line was August, 1876, at Brantford. He hastened to patent his invention, and the same year exhibited it at the Philadelphia Centennial Exposition, where a memorable display of its speaking powers was made on June 25, 1876, before Sir W. Thomson, the Emperor of Brazil, and others. Prof. Bell has taken out a great many United States patents, as sole or joint inventor, the most important being, of course, the one on which is based the speaking telephone of to-day. The photophone, however, upon which he has worked, stands high also as a scientific achievement. Being decreed the French Volta prize, he devoted the money to the establishment, in Washington, of the Volta Laboratory, with a view to original investigation in the transmission and reproduction of articulate sounds; and the Association, as it was called, formed at that place included Mr. Chichester A. Bell and Mr. Sumner Tainter. Several inventions have been the result of the labours of the Association, principally the jet telephone and the graphophone. Prof. Bell has also, to some extent given attention to devising improved methods of electrical communication between vessels at sea. Of late years, however, Prof. Bell has mainly devoted himself to his original pursuit, namely, the study of the deaf and dumb, in connection with his father's visible speech; and he has given much thought, with no small measure of success, to the amelioration of the condition of such unfortunates. Immediately after the invention of the telephone and its going into commercial use, Prof. Bell was called upon for Papers and lectures, and for a time he yielded to the demand. Among the most noteworthy of his productions are: "Researches in Electric Telephony," a Paper read before the Society of Telegraph-Engineers, October 31, 1877; "The Production and Reproduction of Sound by Light," a Paper read before the American Association for the Advancement of Science, August 27, 1880, relating to discoveries made by himself and Mr. Sumner Tainter in the art of "Radiophony;" and "The Production of Sound by Radiant Energy," a Paper read before the National Academy of Sciences, April 21, 1881, relating to further investigations of the same nature.

BENESCH, Charles, Jur. Doctor.

Dr. Benesch was born at St. Polten in Lower Austria, educated in the celebrated gymnasiums of the Benedictine convents of Seitenstetten and Melk-on-the Danube, studied law at the Vienna University, and passed in 1873 his examination as doctor of law with honours. Dr. Benesch also served as an officer in the campaign in Bosnia and the Herzegovina, and received the war medal. He at first practised at the Imperial Royal Commercial Court, but in 1874 he entered the service of the I.R. Post Office in the capacity of an administrative official. In 1877 he was ordered on duty to the Ministry of Commerce, and was eventually taken into their permanent service in 1879. There his duties were specially connected at first with the International Postal Telegraph Department, and afterwards with International Telegraph matters. In 1883 he was appointed a vice-secretary in the Ministry of Commerce, and in 1885 was member of the Austrian Delegation at the International Telegraph Conference at Berlin, in the capacity of a *fonctionnaire attaché*. There he first occupied his attention with telephone matters, and on his return worked out the Ordinance for State telephones, mostly on a basis of his own, involving ideas quite new and startling. This work was made into law, with very few alterations, by Ministerial decree of October 7, 1887, and is the basis of the Austrian State telephone system, which does not interfere with the private companies, over which the State has reserves and exercises strict control. For his services in this direction Dr. Benesch was appointed secretary in the Ministry of Commerce, and he may be looked upon as the creator of the present system of State telephony in Austria. Dr. Benesch was one of the Austrian delegates to the Paris International Telegraph Conference of 1890. In 1891 he was charged with the direction of the Ministerial Department for international telegraph matters and telegraph tariffs, and in the following year was appointed Section Councillor in the Ministry of Commerce.

BENNETT, Alfred Rosling, M.I.E.E.

Born in London, March 14, 1850. Educated principally at Belle Vue Academy, Greenwich.

Mr. Bennett went to India in 1869 in the service of the Indian Government Telegraph Department. Spent four years in India, Beloochistan, Persia, and Turkey. Obtained "special mention" certificate from the Indian Government for proficiency in submarine cable and land-line testing. Returned to England in 1873, and became electrician to the Highton Batteries Company, Limited, then working the battery and other patents of the late Rev.

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Henry Highton, M.A. Had considerable practical experience of chemistry here, and assisted Mr. Highton in his endeavours to adapt his gold-leaf telegraphic instrument to signalling through long submarine cables. Retired from the Highton Batteries Company in December, 1874. Was afterwards electrician to the Magneto Company, Limited, for a short period. In 1875 read a Paper on "New Forms of Voltaic Batteries" before the Society of Telegraph-Engineers, in which was detailed a lengthened series of voltaic experiments with the caustic alkalis as exciting chemicals. These experiments ultimately resulted in the invention of the Bennett "tin-pot" battery, patented in 1881. From 1875 to 1880 was engaged chiefly in literary pursuits. Contributed largely to London and provincial journals, and was for some time editor of two London periodicals. In 1877 carried out the exhibition of Mr. Cromwell F. Varley's musical telephone at the Queen's Theatre, Long-acre, which was joined, for the purpose, to the Canterbury Music Hall by two overhouse wires—the first telephone wires ever erected in this country. In May, 1880, accepted an appointment from the United Telephone Company, Limited, as engineering superintendent of their East London District. In January, 1881, went to Glasgow as engineer to Messrs. D. and G. Graham, the proprietors of the Glasgow Commercial Telephone Exchange system. The same year patented and read a Paper on the subject of his "tin-pot" battery before the Philosophical Society of Glasgow. The battery was fully described at the time in *The Electrician*, and has since come into extensive use for telephonic and other purposes. Mr. Bennett also had charge of the first three or four installations of the incandescent lamp in Scotland (1881), and the first coal mine ever lit by electricity (Earnock, near Hamilton, August, 1881), was fitted up under his supervision. For this mine Mr. Bennett designed air-tight safety switches, and variable resistances for regulating the brightness of each lamp. In 1881 patented his telephonic translator (*Electrician*, Jan. 13, 1883), which had been invented the previous year, and which has since been adopted by all telephone companies possessing inter-town trunk lines. The translator was first put into practical use on the iron metallic circuit trunk lines between Glasgow, Paisley, and Greenock erected by the Post Office for the National Telephone Company, and which, after paying for, that company found useless on their hands until Mr. Bennett came to their assistance. In 1882 he invented his well-known corrugated terminal insulator (*Electrician*, Feb. 17, 1883), with which he commenced a crusade against double shackles, then in universal use for over-house telephone work, and which has recently ended in their total abolition. As a result of seeing M. Lazare Weiller's exhibit of bronze wire at the Palais d'Industrie in 1881, Mr. Bennett brought some to this country, and erected in Glasgow the first light telephone wires, February, 1882. The experiment was successful, and soon resulted in the disuse of the heavy iron and steel wires previously employed. In April, 1883, Mr. Bennett joined the old National Telephone Company as engineer for Scotland and Ireland, but after a few months was promoted to be General Manager for Scotland, Cumberland, and Westmoreland, an appointment he held until October, 1890, when differences of opinion with the newly-constituted Board of the amalgamated National Telephone Company led to his resignation. During Mr. Bennett's long connection with the National Telephone Company he completely revolutionised their methods of work, introducing everywhere light wire and the system of over-house construction which has since become almost universal in the United Kingdom. Under Mr. Bennett's management telephony attained a more advanced state of development in Scotland and Cumberland than in any other part of the country, villages of only a few hundred inhabitants supporting exchanges and enjoying trunk line communication before many towns of 40,000 and 50,000 inhabitants further south possessed any telephonic facilities whatever. The first copper metallic circuit inter-town trunk lines were erected in Scotland in 1884. In erecting the first of these, the Dundee-Arbroath, Mr. Bennett introduced the "cross" system of neutralising induction, which was found entirely satisfactory. In Scotland, too, the first public telephone call offices were opened. In connection with these Mr. Bennett invented his method of checking payments by means of adhesive stamps of values ranging from one penny to one shilling, for which stamps he prepared the designs. Mr. Bennett was the originator of the Edinburgh International Electrical and Engineering Exhibition of 1890, and in connection with it was a vice-chairman of the Executive Council; joint convener of the Electrical and Lighting Committee, and member of the Engineering Committee. In the last capacity he conceived and carried out the magnificent display of historical and modern locomotive engines which was a feature of the Exhibition. On leaving the National Telephone Company, Mr. Bennett was offered and accepted the general managership of the recently-formed Mutual Telephone Company, Limited, a position he retained until the purchase of the Mutual Company's business by the New Telephone Company, Limited, in March, 1892, when he became general manager and chief engineer to the latter Company. Mr. Bennett is the author of numerous pamphlets, articles, and papers on technical subjects, contributed to various scientific societies. He contributed Papers to the British Association at Cardiff in 1891, on "An Electrical Parcel Exchange" and "The Telephoning of Great Cities."

BERLINER, Emile. Born at Hanover, 1851.

In May, 1870, Emile Berliner emigrated to the United States, where his experiences were of a very varied character. In 1874 a friendly German apothecary in New York presented him with an old edition of Müller's "Physik" (1856), and from that he learned the rudiments of science. Soon after he stumbled across Paul La Cour's researches in phonic wheels, and this drew his attention to the possibility of transmitting speech by telegraph

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wire. His first notion was to connect two vessels filled with mercury by a wire and pass a current through. Talking to one mercury surface, he reasoned, should vibrate the current and emit the sound at the other vessel. Lippman's capillary telephone nearly realised this conception. Returning to Washington in 1876 with the fever of research upon him, he began electrical experiments, and, for the purpose of learning something of practical work, paid frequent visits to the Fire Alarm headquarters. Berliner had just begun making diaphragms and contacts, and had looked up Bell's patent of 1876, when one day Mr. Richards, an operator, showed him, at his request, how to manipulate a telegraph key *à la* Catlin. "You have to press down harder," said Richards, "otherwise it may happen that the sounder at the other end will not respond well." Berliner immediately wanted a thorough explanation of the phenomenon, and it flashed upon him that if pressure made a difference in an electrical contact and modified the current, a vibratory contact would transmit speech by means of undulatory currents. He set to work to study the subject, and tried to transmit speech, using for receiver an apparatus as shown in the Bell patent of 1876. For a transmitter he used metallic diaphragms, touching screws tipped with either platina, steel, or broken lead-pencil points. Following up these researches, Berliner, finding that distance would weaken the effect very considerably, hit upon the idea of placing the transmitter in the primary of an induction coil, and he received the U.S. patent for this idea. In 1878 Berliner became a member of the electrical staff of the Bell Telephone Company. During the next few years his time was occupied with experimenting for the Bell Company, and in watching the manufacture of their instruments in Boston. In 1881 he paid a visit to Europe, and laid the foundation for a telephone factory in Hanover (now J. Berliner's), which has since introduced one of the modifications he invented—the so-called "Universal Transmitter," which can be used under all conditions with like superiority, and is exclusively used by the Austro-Hungarian Government, and in other countries. The Buda-Pest-Vienna-Prague line, 500 miles long, is fitted up with 50 of these instruments. Returning to the United States, Berliner moved to Cambridge, Mass., where he made the first studies which led on later to the gramophone. Touching the theory of the microphonic action of loose contacts, Berliner long ago held that it is the layer of air or gas between loose contacts which, acting as a variable resistance on increasing or decreasing thickness, produces the undulations; and that carbon is such an excellent material for a transmitter, because it has the property of condensing a cushion of air upon its surface. A notable "interference" in the United States Patent Office between Berliner, Edison, and others, about the priority of invention of the loose contact transmitting principle, resulted in a complete victory for Berliner, who received broad letters patent therefor. Among Berliner's other inventions of interest to electricians are his molecularium and his secondary battery. The former is an instrument of very simple principle, to illustrate the effect of the electric current by means of a single mechanical movement—that, namely, of the rotatory vibration of molecules. In his storage battery 5 per cent. of alcohol is added to a Planté type of cell, with the result that fresh lead plates form in a few minutes. Berliner has also brought out a superior spongy carbon, obtained by heating ordinary battery carbon to redness for several minutes in an open fire. This burns out the lighter hydrocarbons, leaving a spongy or capillary structure which increases the power to depolarise and decreases the resistance. In such a spongy carbon the gases will themselves give rise to currents if a piece of unburned carbon be used as the other electrode. Berliner was also the first (1877) to discover that an electric contact connected to a membrane would act as a reproducing telephone instead of a Bell instrument. Of inventions not electrical Berliner's chief effort has been the gramophone, which he has only lately perfected, although experimental toy machines have been sold during the past year or two in Great Britain and Germany. In the gramophone a zinc disc is covered with a highly-sensitive etching ground, into which phonautographic sound records are traced spirally. The disc is then immersed for fifteen minutes in chromic acid, which etches the sound records into the zinc. From this original record copies can readily be made by impressing electrotyped matrices into celluloid or hard rubber. In the reproducer the spiral groove, while vibrating a very stiff sounding spring, which is connected to a diaphram, also guides the stylus from periphery to centre. A detailed account of this machine appears in the *Journal* of the Franklin Institute for June, 1888.

BIDWELL, Shelford, M.A., LL.B., F.R.S., M.I.E.E., Barrister-at-Law. Born at Thetford, Norfolk, March 6, 1848; educated at Caius College, Cambridge; graduated B.A. (mathematical honours) in 1870; LL.B. (honours in law), 1871; M.A. in 1873. Also obtained a first class in the Special Examinations in Applied Science for the Ordinary Degree, in December, 1869.

Mr. Shelford Bidwell is the author of numerous papers describing investigation in matters relating to electricity and magnetism, which have been published in the *Proceedings* of the Royal and Physical Societies, the *Journal* of the Society of Telegraph-Engineers, the *Philosophical Magazine*, and other scientific periodicals. He has also delivered many lectures, chiefly upon subjects connected with electricity, at the Royal and London Institutions and elsewhere. Mr. Bidwell was a member of the Jury of the International Exhibition of Electricity held in Paris in 1881; member of the Council of the Physical Society, 1882-4, and of the Council of the Society of Telegraph-Engineers, 1883. He was elected a vice-president of the Physical Society in 1885, a Fellow of the Royal Society in 1886, and a Manager of the Royal

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GUSTAV BINSWANGER.

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Institution in 1892. He is a Director of the Edison and Swan United Electric Light Company.

BINSWANGER, Gustav. Born in Bavaria in 1855. Educated at the Polytechnikum, Augsburg.

Mr. Binswanger has resided in England since 1873, becoming naturalised in 1879, when he began business as an electrical engineer and manufacturer of electrical apparatus. The factories and business establishments he has conducted since that period have experienced a rapid growth and extension in keeping with the increase of electric lighting and telephonic business in general. To Mr. Binswanger's efforts and business and technical capacity are due a number of improvements in the use of electricity for lighting, motive power, cooking, and heating. We will mention only his early introduction of electricity meters, his improvements of electric fittings such as switches, ceiling roses, connectors, &c., his introduction of electric motors for domestic purposes, and his system of electric cooking and heating. Mr. Binswanger's attention was also given at an early date to telephony and electric signalling, and the position which his house holds in this branch of applied electricity testifies to the success which has attended his efforts. Mr. Binswanger is principal proprietor and Managing Director of the General Electric Company, a member of the Institution of Electrical Engineers, Fellow of the Society of Arts, and is on the Council of the London Chamber of Commerce.

BLÁTHY, Otto Titus, was born in 1860 in Totis, a small provincial town in Hungary.

He attended the Realschule and Polytechnicum at Vienna, and graduated there as mechanical engineer in 1881. The next two years he was engaged as draughtsman in the works of the Hungarian State Railways at Budapest, and in 1883 entered the electrical department of Messrs. Ganz and Co. at Budapest, as mechanical and electrical engineer, Since 1885 he has been principally engaged in developing the dynamos and the transformer system used by that firm, as also in designing alternate-current motors, meters, and other accessories. He has made also a special study of the steam engines and water motors best adapted for working electrical supply works. The chess world knows him as one of the most original problem composers living.

BLONDEL, André E. Born in Burgundy, France, 1863.

Received his first scientific education at Dijon; was admitted in 1883 in the Ecole Polytechnique, of Paris, and afterwards as a State Scholar in the Ecole des Ponts et Chaussées. During the same time he graduated Licencié of Mathematical and of Physical Sciences at the University of Paris. After a successful competition, where he obtained No. 1 of the list, he was appointed in 1888 Ingénieur des Ponts et Chaussées (State Engineer for Public Works). In 1887 he was appointed to the Central Light-house Service, where he pursued various experiments on electric lighting. Though gravely and continuously ill since that time, he contributed many Papers on electrical subjects, chiefly on alternating currents and arc light. In 1893 he lectured on electricity at the French National School of Mines, as a substitute to Prof. Potier; he was some months later selected as the first occupant of the Chair of Applied Electricity in the Ecole Nationale des Ponts et Chaussées, of Paris.

BLONDLOT, René Prosper, Doctor of Science. Born at Nancy, 1849.

From 1875 to 1882 Dr. Blondlot was demonstrator at the Physical Research Laboratory at the Sorbonne, and is at the present moment Professor of Physics at the Nancy Faculté des Sciences. He is the author of numerous memoirs on various physical subjects and of two text-books—one on thermo-dynamics, and the other on electrostatics. He has recently succeeded in proving experimentally that the speed of propagation of electrical waves is the same as that of light waves. He is the inventor of an electricity meter which received a premium in the Paris Municipal Meter Competition of 1889.

BOTTOMLEY, James Thomson, M.A., D.Sc., F.R.S., F.R.S.E., F.C.S. Born at Fortbreda, co. Down, Ireland, Jan. 10, 1845; educated at private schools, Queen's College, Belfast, and Trinity College, Dublin.

After taking the degree of B.A., with first honours and gold medal in Chemistry and Natural Philosophy, Queen's University, 1866, Mr. Bottomley was appointed Senior Scholar at Queen's College, Belfast; and assisted Dr. Andrews, the Professor of Chemistry, in his classical research on the continuity of the liquid and gaseous states of matter. Took degree of B.A. in Trinity College, Dublin, and M.A. degree, Queen's University, in 1867, with first honours in Chemistry and Natural Philosophy, and gold medals. Became assistant to the late Dr. W. A. Miller, Professor of Chemistry, King's College, London, 1868. Was transferred to be Demonstrator in Natural Philosophy in King's College, London, 1869. Became Lecturer on Natural Philosophy in the University of Glasgow at the commencement of Session 1869-70. Is Doctor of Science of the Royal University of Ireland, Fellow of the Royal Society, of the Chemical Society, and of the Royal Society of Edinburgh, Member of the Institution of Electrical Engineers, of the Physical Society, and others. Author of works on Dynamics, Hydrostatics, and Four-Figure Trigonometrical and Mathematical Tables. Dr. Bottomley also wrote an "Essay on the Progress of Science since 1833" (Conversations-Lexicon); all the articles on "Electricity and Magnetism" in Moxon's Dictionary of Science; also many scientific articles describing his own experimental researches, including "Thermal Conductivity of Water," "Permanent Temperature of Conductors," and a number of valuable Papers on "Thermal Radiation in Absolute Measure," communicated at intervals during the last seven years to the Royal Society, &c., &c.

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BOYS, Charles Vernon.

Mr. Vernon Boys is the youngest son of the Rev. Charles Boys, of Wing, Rutland. He was educated at Marlborough College and the Royal School of Mines. After acting for a time as assistant to the late Dr. Guthrie, he was in 1881 appointed Demonstrator, and in 1889 Assistant Professor, of Physics at the Normal School of Science and Royal School of Mines, now called the Royal College of Science, South Kensington. He was elected a Fellow of the Royal Society in 1888, and in 1889, after serving on a jury in the Paris International Exhibition, was nominated to the distinction of "Officier de l'Instruction Publique." He is the author of several Papers published by the Royal Society, the Physical Society, the Royal Institution, and the Society of Arts, of which those of most interest to electricians are on "Integrating Machines," on "Quartz Fibres," on the "Radio-Micrometer," and on "Electric Oscillations." Mr. Boys is the author, also, of the supplement to Dr. Guthrie's "Electricity and Magnetism," and of "Soap Bubbles and the Forces which Mould Them."

BRIGHT, Charles, F.R.A.S., F.R.G.S., Assoc. M. Inst. C.E., M.I.E.E. Born at Lancaster Gate, London, in 1863. Educated at Lancing College, and at King's College, London, under Prof. Grylls Adams, F.R.S.

In 1881, Mr. Bright became a pupil of his father, the late Sir Charles Tilston Bright, C.E., M.P., whom he assisted at the Paris Exhibition of that year, at which Sir Charles was a Commissioner appointed by the Government for Great Britain. In 1882, Mr. Bright went out on a cable-laying expedition, which had for its object the laying of 3,500 miles of submarine cable in the Pacific Ocean, between Peru and Mexico, for the Central and South American Telegraph Company, touching at Panama and other intermediate points; during the latter part of the laying of which he was ashore on the coast of Mexico, for the testing of the cable and communication with the ship during laying. Mr. Bright has since been engaged continuously for the last 12 years, both on the engineering and electrical staffs of the India Rubber, Gutta Percha and Telegraph Works Company, in the construction, testing, laying, and repairing of various submarine cables, as well as in land line work, and in various preliminary surveying and sounding expeditions. He was engaged on the Spanish National Telegraph Company's cable expedition in 1884 for connecting up telegraphically Spain with the Canary Islands. In 1885, he was engaged on the laying of cables for the extension of the same system between the Canary Islands and Senegal by 1,000 miles of cable, and a year later on the West African Telegraph Company's cables of 4,000 miles down the West Coast of Africa to the Cape of Good Hope. Mr. Bright has also been engaged in the repairs of cables in the West Indies and elsewhere. In some of these expeditions he has had charge of the electrical operations aboard as well as ashore, and has also been in charge of the electrical testing work of the Submarine Department at the Silvertown Works. Mr. Bright has taken prominent part in many of the discussions arising on papers read before the Institution of Electrical Engineers, of which he is a Member; and has also contributed papers and articles to the electrical journals and to electrical handbooks. He became a student of the Institution of Civil Engineers in 1882 (and was on the committee of that class of the Institution), and became an Associate-Member of that Institution in 1889. Mr. Bright is also a Fellow of the Royal Astronomical Society and the Royal Geographical Society. He holds a commission as Captain in H.M. Militia, and has also taken a prominent position in the athletic world.

BROWN, Charles Eugen Lancelot.

Born in Winterthur, Switzerland, June 17, 1863.

Mr. Brown was educated at the Gymnasium and the Technical School at Winterthur. After serving a one year's apprenticeship in Mr. Bürgin's establishment, in Basle, he organised a small electrical department at the Schweizerische Locomotiv- und Maschinen-fabrik at Winterthur. In 1884 he was engaged by the Oerlikon Company, and within two years thereafter became Director of the electrical department of this well-known firm. His name first became known to the public through his connection with the Solothurn-Kriegstetten electric transmission of power in Switzerland, when he was barely 23 years of age, by which installation he proved that electric transmission of power was practically possible, and which was the cause of a great number of such utilisations of hydraulic power at great distances. At the Paris International Exhibition in 1889 the only grand prix awarded to dynamos was won by his machines. Among some of the works in which he has more recently been engaged, may be mentioned the transmission of power at Cassel, where by means of single-phase alternating currents he transmitted 200 H.P. over 6 kilometres. His work in big low-tension dynamos for production of aluminium has been especially successful, and dynamos up to 600 H.P. are actually at work. His studies in this direction led him to the construction of unipolar machines and to the design of a dynamo of this type actually giving 3,000 amperes at 10 volts, which can be considered as the first really practical unipolar dynamo. More recently he has worked at the high-tension line, and he first called attention to the fact that it is possible to produce and transmit high-tension currents of 20,000 volts or more over long distances by naked wires on suitable insulators, the outcome of which was the now renowned Frankfort-Lauffen transmission. Mr. Brown has also been actively engaged in developing the multiphase system; a 300-H.P. three-phaser and transformer of the same capacity, and a non-synchronous motor with no sliding contacts, are already well-known. In 1891 he left the Oerlikon Works, and established himself at Baden, carrying on the manufacture of electrical machinery. In 1891-92 he devoted himself to the development of practical single-phase alternate-current motors,

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and large numbers of his machines are now in use. In the early part of 1893 what is probably the slowest-running dynamo in the world was constructed at his works: it is for 100 H.P. at 30 revolutions, and is coupled direct to a turbine shaft.

BRUCE, Eric Stuart, M.A. (Oxon), Fellow of the Royal Meteorological Society, Member of the Society of Arts, and Member of the Aeronautical Society of Great Britain. Is the only son of the late General Michael Bruce, who commanded the Grenadier Guards. He was born August 20, 1855, and educated at Radley College and at Exeter College, Oxford.

Mr. Bruce commenced lecturing on scientific matters while still an undergraduate, and after taking his degree he appeared at the Steinway Hall, London, lecturing on the "Electric Light" with such success that, immediately afterwards, in February, 1883, he took the Egyptian Hall for six weeks for a series of lectures on electricity. This was followed by various provincial lecture tours. In 1885 he brought out the "Electrical Translucent Bruce Balloon," for flashing signals by night by electricity. This was exhibited in model in the War Department of the Inventions Exhibition, and exhibited nightly at the Albert Palace, Battersea, for a month. At this time Mr. Bruce was lecturing at the Albert Palace on balloon signalling, and giving a series of afternoon lectures on "Science and War," at the Crystal Palace. In October, 1885, at the invitation of the Secretary of State for War, Mr. Bruce carried on a series of balloon signalling experiments before a Committee of Royal Engineers at Chatham. The report made was so favourable that he immediately received orders to supply some balloon signalling apparatus to the Royal Engineers; and in the following January, 1886, a second successful trial took place at Aldershot at the Army Signalling School, under the superintendence of Major Thrupp. The invention is patented in all principal countries. In January, 1887, Mr. Bruce lectured on "War and Ballooning" at the London Institution, and conducted another lecture tour in the provinces. In April, 1887, he lectured at the Princes' Hall, Piccadilly, on "Science and the Jubilee." In September, 1887, he received an order for apparatus from the Belgian Government, then about to adopt his system. In the same month, at the invitation of the Roumanian War Minister, Mr. Bruce conducted a series of successful experiments at Lillie Bridge Grounds, before a delegate sent purposely to London by the Roumanian Government to report on the system, with a view to its adoption in that country. Mr. Bruce has quite recently been to Antwerp, by the invitation of the Belgian War Minister, to conduct some balloon experiments before the Royal Engineers. These experiments took place under the presidency of General Wouvermans, the Inspector-General of Fortifications at Antwerp. Delegates from Holland, Italy, France, and Russia were sent to Antwerp to witness these experiments, and the Belgian Government has now adopted the Bruce system of balloon signalling. In May, 1889, Mr. Bruce exhibited, by request, at the *conversazione* of the Royal Society, his new optical invention, the electro-graphoscope, for showing dissolving views without a screen. This invention has been worked out on a large scale and was exhibited under the title of the aerial graphoscope during the autumn of 1891 at the Photographic Society's Exhibition in Pall Mall. In February, 1890, Mr. Bruce read a paper before the Royal Meteorological Society on "An Optical Feature of the Lightning Flash." In 1891 he conducted several extensive lecture tours, and amongst his lectures in the Metropolis was one on "Fogs and their Prevention," written at the request of the Sunday Lecture Society, delivered at St. George's Hall. In March, 1892, Mr. Bruce read a Paper before the Physical Society on the aerial graphoscope, and in the summer of that year conducted experiments at the Stamford Bridge Grounds with his latest improvements in electric balloon signalling before General Prince Edward of Saxe-Weimar and other military and naval authorities. He also took part with his electric balloon in the Military Tournament in Cork. In January, 1893, Mr. Bruce read a paper on "Electric Balloon Signalling" at the Royal United Service Institution, Gen. Sir G. W. A Higginson, K.C.B., late Lieutenant of the Tower of London, being in the chair. In the following June he read a paper before the Aeronautical Society of Great Britain on "The Working of Captive Balloons in Windy Weather."

BUMSTED, F. D., J.P., M.I.M.E. Born in 1847. Educated at King's College School and afterwards in the College, and was for five years in the workshops of the College.

In 1870 Mr. Bumsted went to the great engineering works of John Elder and Co., Glasgow (now the Fairfield Shipbuilding and Engineering Company), where part of his apprenticeship was served. In 1874 he built the Cannock Chase Foundry and Engine Works (now Messrs. Bumsted and Chandler), which have yearly increased in magnitude since that date. Mr. Bumsted is the inventor of the world-renowned machinery for the manufacture of paper bags. In 1885, in the early days of house lighting by electricity, Mr. Bumsted personally superintended the lighting of his house with 30 E.P.S. cells, the whole installation having worked highly satisfactorily ever since. In the beginning of 1888 Mr. Bumsted was called to the magisterial bench.

CAPITO, Charles, C.E., M.I.M.E., M.I.E.E. Born in Copenhagen and educated in the same city.

After serving his apprenticeship as a mechanical engineer, Mr. Capito studied for several years at the University of Copenhagen and there took his degree as "Master of Engineering." In 1877 Mr. Capito was appointed chief engineer to the Kryolite Mining and Trading Company of Copenhagen, and subsequently went to the Company's mines at Ivigtut in Greenland. In 1880, however, he came to England, and was soon afterwards engaged in the City and Guilds of London Institute as

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assistant to Prof. Ayrton, F.R.S., and from this time his career as an electrical engineer may be said to have commenced. In 1882 Mr. Capito was appointed chief electrical engineer to the Electrical Power Storage Company (Limited). In this position he was responsible for all experimental work as well as for the manufacturing of the E.P.S. cells. He also represented the Company as an expert in the United States, Berlin, and Vienna during the negotiations for the sale of the Company's patents. In 1884, Mr. Capito went into business as a consulting engineer, in addition to which he joined the late Hanover-square School of Electrical Engineering as Senior Instructor. On the closing of the latter school in February, 1893 he was offered charge of the Engineering Instruction at the Electrical and General Engineering College, Penywern House, Earl's Court.

CARDEW, Philip, Major Royal Engineers. Born Sept. 24, 1851. Took honours at R.M. Academy at Woolwich in 1868, and in 1871 obtained a commission in the Royal Engineers, being at the same time awarded the Pollock gold medal as the most distinguished cadet of the season.

Placed in charge of the Military Telegraphs at Bermuda in 1876, Major Cardew in 1877 joined the Submarine Mining Service, and a year later was appointed Assistant Instructor, and in 1883 Instructor in Electricity at Chatham. As an inventor, Major Cardew has contributed not a little to the advancement of science. Among the principal of his inventions are a cheap and easily replaceable form of projector for the electric search light used in the military and naval services; a system of dynamo winding; a voltmeter, applicable to both continuous and alternating currents, for which a gold medal was awarded at the Inventions Exhibition of 1885; a method of measuring large currents and very small resistances; and a system of vibration telegraphy which has been used successfully in recent campaigns, and which forms the basis of the system of communicating with trains in motion now in use in the United States. Major Cardew is a member of the Institution of Electrical Engineers, and is Electrical Adviser to the Board of Trade.

CARHART, Prof. Henry S., M.A., LL.D. Born at Coeymans, Albany County, N.Y., March 27, 1844.

During the early years spent on his father's farm the district school furnished the principal means of intellectual growth within his reach, but sometimes a college man was employed as teacher, and this afforded an opportunity to study the university algebra and other subjects outside the ordinary range of instruction. At 19 young Carhart was at the head of a Quaker school a few miles from Poughkeepsie, teaching and earning means to complete his preparatory course at the Hudson River Institute at Claverack, and soon prepared in mathematics, largely by teaching the subject to pupils older than himself. In 1865 he was admitted to Yale College, but at the opening of the college year entered the Wesleyan University at Middletown, Connecticut, from which he graduated in 1869. He was employed for two years as teacher of Latin at Claverack, and then sought again the congenial atmosphere of college life. This time it was the Yale Divinity School; but during the year spent at Yale the advantages offered by the Sheffield Scientific School proved too strong to be resisted. The work in German, under Prof. Whitney, turned his thoughts and purposes towards the teacher's life and scientific pursuits, to which he has ever since been devoted. In 1872 Mr. Carhart accepted an appointment in the North-western University at Evanston, first as instructor, but the next year as Professor of Physics, which chair he continued to fill until appointed to the Professorship of Physics in the University of Michigan in 1886. In 1881, he spent a year abroad. He attended the Paris Exposition of Electricity as one of the International Jurors of Award for the United States, after which he took a course of study and experimental work in the Helmholtz laboratory at the University of Berlin. The result of his work here was the production of a standard cell for the measurement of electromotive force, which is now in use in the leading physical laboratories of the United States. The department of electrical engineering, recently established in the University of Michigan, over which Prof. Carhart now presides, has attracted students in large numbers, of three colleagues. As a member of the Committee on Physics Teaching of the American Association for the Advancement of Science, he joined with Prof. Mendenhall and others in a report on this subject, published in the proceedings of the Cleveland meeting in 1888. Prof. Carhart has been a frequent contributor to the leading scientific and technical journals, and has recently published a work on "Primary Batteries," which is well known in this country, and a book on "The Elements of Physics." Prof. Carhart was one of the official delegates to the recent International Electrical Congress in Chicago, and he was President of the Committee of Judges of Award in the department of Electricity for the World's Fair. In 1893 his *alma mater* conferred upon him the honorary degree of Doctor of Laws.

CHANDLER, Noel, M.I.M.E. Born at Epsom, Surrey, 1851; was educated at King's College School, and afterwards at the College, London, and studied for five years in the workshops of the College.

In 1870 Mr. Chandler went to the works of John Elder and Co., Glasgow (now the Fairfield Shipbuilding and Engineering Company), where a part of his apprenticeship was served. From there Mr. Chandler went to Messrs. Clayton and Shuttleworth's, of Lincoln, with the object of obtaining a varied experience. In 1874 he was engaged as manager of the Cannock Chase Foundry and Engine Works, which had just then been completed; and in 1890 he became a partner with Mr. F. D. Bumsted. He is the inventor and patentee of the well-known high-speed engine bearing his name, which is being largely adopted for electrical purposes. Mr.

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RICHARD COLLETT.

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Chandler is also the patentee of a very efficient fan, largely used on steamships for forced draught, and in coal mines for ventilation.

CLARK, Latimer, C.E., F.R.A.S., F.R.S., Past President of the Society of Telegraph-Engineers and Electricians. Born at Great Marlow, March 10, 1822.

At first connected with the chemical manufacturing industry, he commenced railway surveying in 1847, and was appointed assistant engineer for the construction of the Britannia Tubular Bridge across the Menai Strait, under his brother, Mr. Edwin Clark, the resident engineer. During his stay at Menai Bridge Mr. Latimer Clark used electricity to fire a time-gun every evening at 8 o'clock. The attention of the Chairman of the Electric Telegraph Company was, through this, called to the young engineer, who, in 1850, was appointed assistant-engineer to the company, under his brother, becoming afterwards their engineer-in-chief and consulting engineer. Many improvements in the telegraph system were introduced by him; and a very able report on the subject of underground telegraph wires was made by him in 1860, which was embodied later on in the Government report in 1861. He was the first to witness the retardation of electric signals by induction in submarine lines, and to demonstrate that currents of low tension travel as fast as those of high tension. In 1856 Mr. Clark invented and patented the double cup insulator for overland telegraph wires, now universally employed throughout the world. To him we owe the important invention, in 1854, of the pneumatic transmission of messages, now so largely used. The invention of a method of protecting submarine cables by Clark's compound followed in 1858. In 1860 he acted as a member of the committee appointed jointly by the Government and the Atlantic Cable Telegraph Company to inquire into the whole subject of submarine telegraph cables. Mr. Clark was also for many years engineer to the Indian Government cable lines in the Persian Gulf. As head of the firm of Clark, Forde and Co., he was connected with the submergence of some 50,000 miles of submarine cables in all parts of the globe. His determination of the effect of temperature on the insulation of gutta-percha cables, in connection with Sir Charles Bright, in 1863, proved highly valuable, and is still in daily use. He also, in connection with the same gentleman, originated, in 1861, the system of electrical measurement in ohms and volts which has now come into general use and has conferred such vast benefits on electrical science. He is also the inventor of the well-known Clark's standard cell. We may mention the publication by him, in 1868, of a Treatise on Electrical Measurement, and in 1871, in conjunction with Mr. Robert Sabine, of his electrical tables and formulæ for operations in submarine cables, besides other Papers of great value. Mr. Latimer Clark has taken out a large number of patents in different countries, many of his inventions being of great value. For a number of years a partner in the engineering firms of Clark and Standfield, and Latimer Clark, Muirhead and Co., he has brought out many important improvements in different branches of engineering. Mr. Clark is also the author of several astronomical works, and of a very valuable Dictionary of Metric and other Useful Measures. He is a Chevalier of the Légion d'Honneur.

COLLETT, Richard, M.I.E.E. Born at Fairford, Gloucestershire, in 1825. Educated at a private school, and subsequently by private tuition.

Mr. Collett entered the service of the Atlantic Telegraph Company in 1857, on the electrical staff, and was stationed in Ireland during the attempt to lay the Atlantic cable in that year. He assisted in the experiments made on the cable in the following winter at Devonport, and was on board Her Majesty's ship "Agamemnon" during her operations in 1858, including the laying of the cable. After communication with Newfoundland totally ceased he remained at Valencia, in charge of the station, until 1860, when the enterprise was for the time abandoned. In the same year he received an appointment from the Indian Government on the Rangoon and Singapore cable, as superintendent in charge at Singapore, but circumstances prevented the cable being laid. In 1861 he entered into an engagement with Messrs. Glass, Elliot, and Co. (afterwards the Telegraph Construction and Maintenance Company); assisted at the laying of the Malta and Alexandria cable; was in charge at Alexandria when the line opened for traffic; and afterwards acted as travelling superintendent of the above-named company until 1866, when he was appointed traffic manager jointly to the Atlantic Telegraph and the Anglo-American Telegraph Companies, and assisted on board the "Great Eastern" at the laying of the 1866 Atlantic cable. The management afterwards falling solely into the hands of the Anglo-American Telegraph Company, he continued to hold the same position until leaving the service in 1870. On the formation of the Brazilian Submarine Telegraph Company he was appointed secretary, and now holds that position. He was traffic manager of the first Atlantic cables opened to the public; is one of the original members of the Society of Telegraph-Engineers (now the Institution of Electrical Engineers); and received from the Emperor of Brazil the decoration of Knight Officer of the Order of the Rose.

COLOMBO, Giuseppe. Born in Milan in 1836; obtained diploma of Civil Engineer at the University of Pavia in 1856.

Signor Colombo applied himself to electric lighting in 1882, when he went to America to see Mr. Edison's installations. On his return he made the plans for the Electric Central Station of Milan, which now supplies 35,000 glow lamps and 1,000 arc lamps to that city. He was for some time the General Director of the Società Generale Italiana d'Elettricità, which works the Central Station of Milan, and has executed numerous installations of electric light throughout Italy. In 1890 he was appointed Minister of Finance in the Italian Government.

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COTTERELL, Arthur Edgar. Born at Moseley, May 15, 1864; educated at the Birmingham and Edgbaston Proprietary School, subsequently under the private tuition of the late Prof. J. H. R. Bayley. He also attended the Mason Science College, at Birmingham.

In November, 1879, Mr. Cotterell entered the service of the Midland Telephone Company, Limited, in Birmingham. On the taking over of that Company by the National Telephone Company, Limited, his services were retained by the latter Company until his resignation in October, 1884. During the period of his engagement with the latter Company, Mr. Cotterell paid particular attention to the question of inductive disturbances, and carried on many and varied experiments with underground and overhead cables and systems. He also designed and invented several systems and exchange connections for general telephone work. He is an ardent supporter of overhead telephone and telegraph wires, and having been connected with telephony from its first appearance in Birmingham, is well known there. Among his more recent inventions may be mentioned a new form of telephonic call-box, to be used at the various call offices open for the use of subscribers and the public. By means of certain acoustic arrangements the operators at the Telephone Exchange are enabled to readily recognise the various coins paid in by the would-be user. Apertures are provided for subscribers' tokens, and, on the insertion of these, easily recognisable signals are transmitted, showing whether the person is entitled to use the trunk or local connections. He has also invented an apparatus for overcoming or minimising induction on telephone circuits. At the time of his resignation of the National Company, Mr. Cotterell had had for some time the superintendence of the whole electrical system, both in Birmingham and the Brierley Hill districts. In January, 1885, he joined his brother (Mr. C. W. Cotterell, surveyor) to practise as surveyors and electrical engineers. On the 10th October, 1885, he delivered a lecture on "The Development of Telephony" before a large meeting of the members of the South Staffordshire Institute of Iron and Steelworks Managers. In April, 1886, Mr. Cotterell accepted the appointment of Local Manager of the National Telephone Company, Limited, in the Potteries. In the June following he was appointed to the managership of one of the Company's largest centres, which comprises Birmingham, Wolverhampton, Wednesbury, and Walsall. Mr. Cotterell is the author of numerous articles and papers on various electrical and, particularly, telephonic matters, and has delivered many lectures on these subjects. Among these may be mentioned "Telephony Past and Present," "Disturbances on Telephone Circuits," "A Few Errant Notions on Telephone Matters," "The Development of Telephony," "Electricity—Terrestial, Celestial, and Up to Date," "Electrical Phenomena and Their Relation to Telephony," etc., etc. Mr. Cotterell now occupies the post of District Manager for the large area known as the Birmingham District.

COUR, Paul La. Born in Jutland, 1846.

M. Paul La Cour was educated at the University of Copenhagen. In 1872 he was Vice-Director of the Meteorological Institution in Copenhagen, but since 1878 he has been Professor at the High School in Askov (Jutland). For a treatise on the measurement of the height of clouds the Royal Danish Academy of Science awarded him a special silver medal in 1872. In 1874 he invented the phonotelegraph, and the same Academy awarded him a special gold medal. This system is described in the *Journal Télégraphique* of March 25, 1876. In 1876 M. La Cour invented the phonic wheel, an isochronous apparatus, the movement of which is regulated by an intermittent electric current. In 1877 he arranged a synchronism of two phonic wheels at different telegraphic stations, and in 1882 he improved the synchronising apparatus so that it was applicable to different kinds of telegraphy. In the same year he sold his American patent rights in connection with the phonic wheel. In 1888 M. La Cour devised spectro-telegraphy, a kind of optical telegraphy by which combinations of rays of different refrangibility are sent; and the signals are read through a spectroscopical telescope as Morse-letters, the size of which is independent of the distance. In 1891 he invented an astatic regulator, called the "Kratostat," which ensures absolutely steady running in steam engines, and also regulates the speed of wind and water motors, &c. M. La Cour has received several medals for his scientific labours.

COURTENAY, John Irving, is an M.A. of Trinity College, Oxford, and a Barrister-at-law of Lincoln's Inn.

Mr. Courtenay took an active part in the introduction of the electric light on a commercial scale into this country. In 1882 he associated himself especially with the development of the storage battery industry; and, as a Director and afterwards as Managing Director of the Electrical Power Storage Company, which then owned the secondary battery patents of Faure, Sellon, Swan, King and others, spent much time in representing in various European countries and in the United States of America the patent rights and interests of that Company. Mr. Courtenay is Chairman and Managing Director of the Electrical Power Storage Company, and Chairman of the Chelsea Electricity Supply Company, and of the United River Plate Telephone Company, and is well known in electrical circles as taking a very real interest in the development of the electrical industries.

COUSENS, R. Lewis, M.I.E.E. Born 1860; educated at St. Olave's Grammar School, Southwark, and subsequently by private tuition.

Mr. Cousens, in 1880, entered the School of Electrical Engineering and Submarine Telegraphy at Hanover-square, London, W., and in 1881 joined the Anglo-American Brush Electric Light Corporation, Limited, as electrician. In October he was transferred to Messrs. Hammond and Co. (afterwards the Hammond Electric Light Company), and assisted at several of their in-

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stallations. From there he went to South Africa, and carried out installations for the (late) South African Brush Electric Light Company, at Port Elizabeth and at Kimberley. In 1884 the plant at Kimberley was sold to the Borough Council of that place, in whose service he entered as borough electrician. Besides carrying out the work of the public lighting of the town of Kimberley, he completed and superintended the maintenance of the incandescent lighting of the theatre and other buildings, also several large and important arc installations for the various diamond mining companies at the diamond fields. He resigned his position as borough electrician in 1889, and in the following year was offered and accepted the position of general manager and agent in South Africa for Woodhouse and Rawson United, Limited. He is engaged in carrying out installations for his firm in all parts of South Africa.

COWAN, Edward Woodrowe. Born 1861.

Mr. Cowan was educated at Kensington Grammar School, and in 1878 entered the firm of J. J. Thornycroft and Co., Church Wharf, Chiswick, torpedo boat builders, as an apprentice, and remained with them for six years, when he went for two years to Newcastle as draughtsman in the engine and hydraulic department of Sir William Armstrong, Mitchell, and Co. In 1886 he left them to assist in the design of the machinery of a torpedo boat which was being constructed by Messrs. Doxford and Sons, Sunderland, and later in the same year joined Mr. Arthur Rigg as his assistant in London, in the following year going to his works in Chester as assistant-manager. Mr. Cowan commenced the study of electrical science under Professor Wilson at the Birkbeck Institution while serving his apprenticeship at Messrs. Thornycroft's, and he subsequently taught the subject under the Science and Art Department. Under Mr. Rigg he first came in contact with electrical engineering, and in 1888 he, in conjunction with Mr. Fawcus, designed a central station for the supply of electricity in Chester; the Town Council, however, refusing to grant their consent to a Provisional Order to their Company, the work has not yet been carried out. In the same year they designed a central station for Keswick, utilising the water power of the River Greta; this work was completed early last year, and has since been enlarged to their plans. Early in 1892 Mr. Cowan undertook the management of the Manchester Edison-Swan Company's works, which position he now holds. Mr. Cowan is the joint author with Mr. Fawcus of two Papers published in the *Transactions* of the Institution of Civil Engineers. He is an Associate-Member of that Institution, and a Member of the Institution of Electrical Engineers.

COX-WALKER, E., M.I.E.E. Born at Stockton-on-Tees, in the year 1838, and principally educated at Holgate Commercial College, York.

Very early in life Mr. Cox-Walker's attention was turned to the subject of telegraphy, and at the age of 13½ years he entered the service of the Electric and International Telegraph Company at York as a junior operator. In 1877 he made his first telephone, from a description which appeared in one of the scientific papers, and from that time to the present he has been continuously engaged upon telephone, lighting, and general electric work. In February, 1878, he made, and provisionally patented, improvements on Bell's telephones, having for their object the increase of their sound by the union into one opening of two, four, eight, or more diaphragms; the use of two ear-tubes on one receiver, as now used for the Gower-Bell telephone, being also patented at the same time by him. In May, 1878, Mr. Cox-Walker exhibited his duplex, quadruplex, and octoplex telephones to the members of the Royal Institution; and has since delivered many lectures on the telephone, electric light, phonograph, and electrical appliances generally before literary, scientific, and other societies in the north of England. In 1878 Mr. Cox-Walker made the acquaintance of the late Rev. Henry Hunnings, then curate of Bolton Percy, and assisted him in his experiments. Between them they perfected the celebrated "Hunnings transmitter," which is acknowledged to be the best transmitter for all telephone work. During his experiments with Mr. Hunnings, Mr. Cox-Walker first made and used an electro-magnetic receiver in conjunction with the Hunnings transmitter. After a long series of trials and experiments he ultimately produced the instrument so well known as the "Cox-Walker receiver." Unfortunately, the United Telephone Company claimed that both the "Hunnings transmitter" and the "Cox-Walker receiver" were infringements of their rights as owners of the patents of Edison and Bell, and brought an action against the firm, which lasted a month in the Court of first instance and six days in the Court of Appeal. The style of the firm is now Cox-Walkers, and is carried on by Mr. Cox-Walker, assisted by his sons, and their business is rapidly extending all over this country and abroad. Large new premises have lately been erected by them for general manufacturing purposes in Feethams, Darlington.

Mr. Cox-Walker has, in addition to the above, made and carried out many useful improvements in electric signalling apparatus for mines, electric bells, magnets, motors, &c. One of his most ingenious and successful inventions is the watchman's tell-tale. This useful machine keeps a record of the movements of the night watchmen of a large building, or a town, or the warders of an asylum or prison, and has met with much commendation from the Commissioners in Lunacy, who are recommending it for adoption in all asylums. Besides the telephones known as above, Mr. Cox-Walker has invented several forms of receivers, some of which have proved very successful. Lately Mr. Cox-Walker's attention has been directed to electric lighting and power, and to the development of a system of bells, &c., for railway, mining, and domestic purposes, which can be worked by a patented form of magnetic generator.

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CROCKER, Prof. Francis B. Born at New York, July 4, 1861 ; graduated at the School of Mines, Columbia College, in 1882, with the degree of E.M.

From 1882 to 1888 Mr. Crocker was associated with Charles G. Curtis, C.E., in the firm of Curtis and Crocker, electrical engineers. In 1886 Messrs. Curtis and Crocker invented the "C. and C." electric motor and battery, and established the "C. and C." Electric Motor Company. During 1888, Mr. Crocker, with Dr. Schuyler S. Wheeler, developed the Crocker-Wheeler electric motors and dynamos. When the course of Electrical Engineering was established at Columbia College, in 1889, Mr. Crocker was placed in charge of it as principal instructor, and he is now the Professor of Electrical Engineering. Prof. Crocker has been Vice-President of the American Institute of Electrical Engineers, and President of the New York Electrical Society. He was general secretary of the International Electrical Congress at Chicago in 1893. Prof. Crocker has contributed to electrical societies and journals a number of papers, which have been well received.

CROMPTON, Rookes Evelyn Bell. Born near Thirsk, in Yorkshire, 1845 ; educated at Elstree Hill School, Harrow School, and in Paris.

Mr. Crompton entered the Army and was appointed to the Rifle Brigade in 1863 ; served with his regiment in India until 1869 ; from 1867 to 1875 held an appointment under the Department of Public Works as engineer in charge of the Government steam train. In 1876 left the service and became a partner in the firm of T. H. P. Dennis and Co., of Chelmsford. A year later he became engineer-in-chief of the Stanton Ironworks Company. Shortly after the completion of the foundry, necessity for working continuously day and night led him to study the possibility of adopting the electric light, which at that date (1877), was a novelty in this country. Early in 1878 he commenced electrical engineering in a small way, supplying Gramme machines and Serrin lamps, and soon superseded these by Bürgin machines and arc lamps of his own invention. A considerable sale for arc lighting sets was soon obtained. At this time the only manufacturers of dynamo machines in England were Messrs. Siemens and Messrs. Wild, of Manchester. Several large railway stations were then lighted by him, and in 1881 the first large installation of incandescent lamps was carried out at the Royal Courts of Justice. About this time Mr. Crompton and Mr. Kapp, who was then his manager, brought out the well-known compound winding of dynamo machines. The first practical application of these machines was for the lighting of Berechurch Hall and for the Royal Courts of Justice. Since that time the Chelmsford works have rapidly developed, and are now among the largest in this country. Mr. Crompton at an early period saw that the great future of electrical engineering lies in the direction of central supply stations, and he therefore, in 1881, allied himself with the Edison-Swan Company and became their designing engineer for a central station situated close to Victoria Station. However, on account of the depression which followed the over-speculation in electric lighting shares in 1883-4, this central station was not carried further than to an extent sufficient to supply the London, Chatham, and Dover Railway Company's requirements. For some years capitalists would not find money for central station supply in England, but Mr. Crompton was fortunate enough to secure an order for a large central station at Vienna, which gave him opportunities of working out his ideas. He there commenced the system which has since been so largely adopted in England, *i.e.*, of dividing up central-station plant into a considerable number of units, as from the experiments he had made at Victoria Station he had discovered that the cause of the great difference which exists between the economical efficiency of plant at full load and its actual economical efficiency as shown by the weekly or monthly working expense accounts, is due to the want of economy of large steam engines and boilers when run for long hours only partially loaded. In order to avoid this loss at Vienna, he divided the 1,600 H.P. required for the station into eight sets of 200 H.P. each, each set being self-contained, direct-coupled Willans engines being employed. A large number of the special features which have since characterised English practice were successfully introduced in this Vienna station. Among these we may mention, in addition to the use of the Willans engines direct-coupled to Crompton dynamos, the use of the 5-wire system combined with accumulators, the use of large accumulator regulator switches having many contacts, the use of shunted Deprez-D'Arsonval galvanometers for accurately measuring the large currents used, the use of a vertical exhaust pipe placed centrally and extending nearly to the top of the chimney, ring main steam pipes, and various other devices which at that time were unknown, but are now universally used. The successful working of this Vienna station gave him confidence to start a similar central station in 1886 in London at Kensington, and the economical results and commercial success obtained from this station from the first month that it was set to work very largely contributed to restoring the confidence of investors in electric lighting supply companies, and which has resulted in their present development. Mr. Crompton has, throughout, been a steady believer in the merits of direct supply, thinking that up to the present date the problems connected with high-pressure alternating current supply and use of transformers have not been sufficiently worked out to make it satisfactory, either from an economical point of view or from that of trustworthiness and freedom from danger. He has from time to time read Papers before the Institution of Civil Engineers, the Institution of Electrical Engineers, and other scientific bodies, upholding these views ; and he considers that, up to the present date, the returns from the various English supply companies which have been a sufficient time at

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WILLIAM CROOKES.

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work, show that, whereas English electrical engineering, exemplified by the results obtained in the various low-pressure electric supply stations, shows to very great advantage compared with other countries, the results from the rival system still leave much to be desired. Mr. Crompton has never ceased to point out that the conditions of electric supply in England differ very widely from those in foreign countries. The habits of Englishmen are such that electric lighting is used to a far greater extent in private houses in this country than is the case on the Continent or in America. The English load diagrams are, therefore, of quite a different character to those found in foreign stations, the periods of maximum load being of a much shorter duration. In a Paper contributed to the Institution of Civil Engineers in 1891, he gave the name of "load factor" to the relation which the actual output of a plant of any given size bears to what would be its output if it were worked continuously day and night at the maximum observed load, and for the same period. He, since then, has continued to point out how much the economical efficiency and design of electric plant are affected by this question of load factor, and how important it is it should be studied before any particular system of plant is adopted. Mr. Crompton has also taken considerable share in the inventive work required in the development of systems of underground mains necessary for central supply stations, advocating the use of bare copper strained over porcelain insulators in concrete culverts. This system has been extensively adopted, and with satisfactory results. He has also interested himself in the question of electrical standards and in the production of electrical measuring instruments of high degrees of accuracy, particularly the potentiometer method, various forms of this instrument having been worked out by him personally. He is a member of the Institution of Civil Engineers and Vice-President of the Institution of Electrical Engineers. He took a considerable share in organising the Electrical Section of the London Chamber of Commerce, and was elected the first Chairman of that Section.

CROOKES, William, F.R.S., P.P.C.S., Past President of the Institution of Electrical Engineers. Born in London in 1832; entered Royal College of Chemistry in 1848 as a pupil of Dr. Hofmann, and gained the Ashburton Scholarship in 1849. In 1850 he became junior, then senior, assistant to Dr. Hofmann, which position he retained till 1854, when he obtained the appointment of Superintendent of the Meteorological Department of the Radcliffe College, Oxford. Elected a Fellow of the Royal Society in 1863.

Mr. Crookes founded the *Chemical News* in 1859, of which paper he is still the proprietor and editor. In 1864 he became editor of the *Quarterly Journal of Science*. He is the author of "Select Methods in Chemical Analysis"; of the "Manufacture of Beet-root Sugar in England"; of a "Handbook of Dyeing and Calico-Printing"; and of a Manual of "Dyeing and Tissue-Printing" (1882)—one of the "Technological Handbooks" prepared for the examinations of the City and Guilds of London Institute. He is also joint author of the English adaptation of Kerl's "Treatise on Metallurgy." He has edited the last three editions of Mitchell's "Manual of Practical Assaying," and has translated into English and edited Reimann's "Aniline and its Derivatives," Wagner's "Chemical Technology," Auerbach's "Anthracen and its Derivatives," and Ville's "Artificial Manures." An authority on sanitary questions, his views have been laid before the public in two pamphlets—"A Solution of the Sewage Question," and "The Profitable Disposal of Sewage." Mr. Crookes, in conjunction with Dr. Odling and the late Dr. Tidy, recently investigated the sanitary condition of the water supply of London. A long series of original investigations must be credited to Mr. Crookes, among which may be noted, 1863, "Sodium Amalgamation Process for Extracting Gold and Silver"; 1872-80, "Repulsion Resulting from Radiation." These investigations gave us the radiometer, and led to the vacuum experiments so valuable in electrical work. In 1879 the Royal Society published in its *Philosophical Transactions* records of Mr. Crookes's experiments on "Molecular Physics in High Vacua," comprising "Magnetic Deflection of Molecular Trajectory," "Laws of Magnetic Rotation in High and Low Vacua," and "Phosphorogenic Properties of Molecular Discharge." In the same year appeared a further Paper on "Repulsion Resulting from Radiation." The subject of his second Bakerian Lecture to the Royal Society was "Illumination of Lines of Molecular Pressure, and the Trajectory of Molecules." In the form of a lecture delivered before the British Association, under the title of "Radiant Matter," he compressed his researches on the electric discharge in high vacua. This lecture, fully illustrated, was reprinted in *The Electrician*. In 1880 the French Académie des Sciences bestowed on Mr. Crookes an extraordinary prize of 3,000 francs and a gold medal, in recognition of his discoveries in Molecular Physics and Radiant Matter. In 1881 Mr. Crookes acted as a juror at the International Exhibition of Electricity in Paris. In this official position he was not entitled to a medal, but in the official report his fellow jurors, after discussing the merits of four systems of incandescent lamps, declared—"None of them would have succeeded had it not been for these extreme vacua which Mr. Crookes has taught us to manage." It is stated that Mr. Crookes was the first to apply photography to the investigation of the solar spectrum; but his earlier researches were so numerous that it is impossible to refer to them all. It is well known that the value of an incandescent lamp depends greatly upon the perfection of the vacuum obtained; and in his Paper before the Royal Society in 1877 Mr. Crookes concluded that the most perfect vacuum then obtained, in which the pressure was only 0·4 millionth of an atmosphere, contains in each cubic centimetre no less than

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250,000,000,000,000 molecules of air, as compared with Mr. Johnstone Stoney's estimate of the number of molecules contained in a cubic centimetre of ordinary air, which is 1,000,000,000,000,000,000,000 (one thousand trillions). In 1883 Mr. Crookes delivered the Bakerian Lecture for the third time before the Royal Society, the subject on this occasion being "Radiant Matter Spectroscopy: the Detection and Wide Distribution of Yttrium." In 1886 Mr. Crookes was elected President of the Chemical Section of the British Association; and at their Birmingham meeting that year he delivered an address in which he propounded some novel speculations on the probable origin of the chemical elements, showing that the balance of evidence was in favour of the view that our so-called elements have been formed by a process of evolution from one primordial matter. In 1887 he delivered a Friday evening discourse before the members of the Royal Institution, on the "Genesis of the Elements." In his address to the Chemical Society in 1888, on taking the president's chair, Mr. Crookes still further elaborated this theory, bringing forward numerous arguments, many of them based on experiments, to prove that the chemical elements are really compound bodies. These views were again urged, with numerous experimental proofs, in his presidential address to the same Society in 1889, and they are now generally accepted by chemists. In 1888 Mr. Crookes was awarded the Davy Medal of the Royal Society, for his Radiant Matter researches. Mr. Crookes was President for 1891 of the Institution of Electrical Engineers. He is a member of the Athenæum, Grosvenor, Savile, and Whitehall Clubs.

CURTOYS, Charles, M.I.E.E. Entered the service of the Electric and International Telegraph Company in 1851.

Mr. Curtoys afterwards became assistant secretary to the British and Irish Magnetic Telegraph Company, and upon the formation of the London and Provincial Telegraph Company was appointed secretary. In this position he remained until the transfer of that company to the Government. Mr. Curtoys has been secretary to the Consolidated Telephone Construction and Maintenance Company since the commencement of that undertaking in April, 1881, and was the first secretary of the River Plate Telephone Company, now amalgamated with another telephone company in Buenos Ayres.

DANVERS, Alan. Born in London on 21st August, 1861, and educated at the Merchant Taylors' School, and Christ's College, Finchley.

Leaving the latter in 1878, he commenced life in a commercial sphere in the City, but the stool proving distasteful, he at the commencement of 1880 went to the Electrical School of Engineering, in Hanover-street, W., from whence, after having studied telegraphy, telephony, and electricity generally, in their practical and theoretical branches, he passed the school examinations, and left. He then took service under the well-known Col. Gouraud, by whom he was sent to Binswood (Upper Norwood) to practise erecting lines and telephone exchanges. Upon the formation of the European Telephone Association, with Col. Gouraud as president, Mr. Danvers was sent to Turin in April, 1881, as assistant engineer, to erect an exchange. He also assisted in the erection of the exchanges at Milan and Venice. Upon the amalgamation of the European Company with other interests, under the new name of the Edison Gower-Bell Telephone Company of Europe, Limited, Mr. Danvers was sent by the company to Lisbon, in which country he can also claim to have erected the first telephone exchange, viz., in January, 1882. At the close of this year he was appointed as the company's sole representative and engineer-in-chief. In 1883 he received the honour of knighthood from the King of Portugal for having constructed and worked the telephone system so successfully; and for having transmitted an opera sung in the Opera House to the Royal Palace, five miles distant, at a time when the Court were unable to appear in public. Amongst other innovations he has adopted in the employment of the telephone, we may mention that in agreement with the Opera House directors, the opera is transmitted to subscribers' houses upon the payment of a subscription for the season, or a small amount per night. At the commencement of 1885 he was honoured with a special mission to Madrid on behalf of his company and the Consolidated Telephone Construction and Maintenance Company, which he carried out with entire satisfaction. Mr. Danvers in July, 1886, again proceeded to Madrid on behalf of the joint interest of the above companies, in order to inspect and report on the state of the existing telephone exchanges in Spain previous to their being put up for "Subasta" by the Government. Upon his return to Lisbon he received a very flattering recognition of his services in Spain from the Consolidated Company. Mr. Danvers in 1887 was instrumental in forming a new company in Portugal, for acquiring the rights and privileges of the Edison Gower-Bell Telephone Company of Europe, Limited, in that country. He is managing director and chief electrician of the Anglo-Portuguese Telephone Company, and has been successful in obtaining on its behalf a valuable concession from the Portuguese Government. Mr. Danvers is a member of the Institution of Electrical Engineers, and of the American Institute of Electrical Engineers. In April, 1893, he was created Baron Danvers, of the Kingdom of Portugal, in recognition of important services rendered during the last few years.

DELANY, Patrick Bernard. Born in King's County, Ireland, in the year 1845, and is the son of a farmer. He was taken to America at the age of ten. Educated in the common schools in Ireland, and parochial school in America.

Mr. Delany entered the telegraph service very early, and at 18 was ranked as first-class operator. At 20 he was considered one of the most expert telegraphists in America, and en-

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joyed the reputation of being able to receive, by sound, from the fastest sender, and keep 20 words behind with his manuscript. Promotion came rapidly to young Delany, until at 25 he was superintendent of an important telegraph company. His first patented invention came out in 1873, and was an improvement in relays. Seven years later this invention was generally considered a valid substitute for the Page Patent Relay, which threatened a monopoly of the telegraph business in the United States. Mr. Delany was identified with an effort to establish automatic or machine telegraphy from 1872 to 1875. He went into journalism from 1877 to 1880, when his first invention of 1873 came into prominence and brought him back into the electrical field. From this time electrical invention became Mr. Delany's constant study. His patents, over 50 in number, cover a wide range. Among the most important are his anti-induction cables, now extensively manufactured at Pittsburg, Penn. The main feature of these cables is the separation of the insulated conductors by walls of lead integral with the enveloping pipes. Mr. Delany's improvements in synchronous multiplex telegraphy, facsimile telegraphy, and ocean-cable transmission are well known all over the world. Quite recently Mr. Delany's system of cable transmission attracted considerable attention by its performance of 20 words per minute, which were received on a Morse sounder, over the Anglo-American cable, from Duxbury to St. Pierre, a distance of nearly 900 miles. 34 words per minute were recorded by a Thomson Recorder. Mr. Delany has been honoured by the Franklin Institute in the bestowal of the Elliott-Cresson Gold Medal and the John Scott Legacy Medal. He received the Gold Medal and Diploma at the Inventions Exhibition, South Kensington, in 1885.

DÉRI, Max. Born at Bács (Hungary), in the year 1854.

From 1872 to 1877 he attended the Polytechnic College at Vienna, and after obtaining the degree of an engineer he showed a pronounced liking for electrical science, and made his first essays with induction apparatus; from 1878 to 1882 he was in the service of the Royal Hungarian Government as a hydraulic engineer, being occupied in the hydraulic works for the regulation of the rivers Danube and Theiss. During this time he continued his electrical studies, and the Hungarian Minister of Public Works sent him to Paris to study the Electrical Exhibition. In 1882 he was engaged as an electrical engineer by the firm of Ganz and Co., Budapest, where he has worked in conjunction with Mr. Zipernowsky and later with Mr. Bláthy. The name of Mr. Déri is connected with a number of inventions in electrotechnics, and in most of them he has worked in conjunction with these gentlemen. The most important letters patent he has taken out are: Self-exciting alternating-current dynamo, 1882; rotating secondary generator, 1884; improved induction apparatus for the transformation of electric currents (transformers), 1885; improvements in regulating alternating currents, 1886; dynamo compensator, 1885; improvements in distributing electricity, 1885; electric-current converting apparatus, 1888; improvements in distributing electric energy, 1888; improvements in alternating-current motors, 1889. Mr. Déri personally superintended the construction of the first alternating-current central stations with transformers of the Zipernowsky-Déri-Bláthy system in Lucerne, Milan, Rome and numerous others for the firm of Ganz and Co., until in 1889 a new company, the International Electric Company, was formed in Vienna of which Mr. Déri was chosen as Managing Director. In this position he has constructed several central stations, amongst them that in Vienna.

DESROZIERS, Edmond. Born in Paris in 1852.

M. Desroziers studied at the Ecole Supérieure des Mines, whose diploma he holds. His principal electrical work has been in connection with the compound dynamo (patented 1881-82), the disc pattern dynamo which bears his name (patented 1886), incandescence lamps of the Cruto and other types, electric measuring instruments (various patents), electrical distribution from central stations, and electric traction on railways (patented 1891). He is expert to the Conseil de Prefecture de la Seine and Chevalier of the Legion of Honour.

DEWAR, James, M.A., LL.D., F.R.S. Born in 1842, at Kincardine.

Prof. James Dewar was educated at Dollar Academy and the University of Edinburgh. He was appointed assistant to Dr. Lyon Playfair, then Professor of Chemistry in the University of Edinburgh, in 1863, and studied subsequently at Ghent. Prof. Dewar is Jacksonian Professor of Natural Experimental Philosophy in the University of Cambridge, and Fullerian Professor of Chemistry in the Royal Institution, which latter chair was formerly held by Faraday. He is the author of numerous Papers on Chemical and Physical subjects. He investigated the physiological action of light, in conjunction with Prof. M'Kendrick, of Glasgow, and succeeded in proving that the effect of light on the living retina is to produce a sudden alteration of its electrical condition. He has delivered many Christmas courses of lectures to the juveniles, amongst them being those on "A Soap Bubble" (1878-9), on "Alchemy in relation to Modern Science" (1883-4), and on "The Story of a Meteorite" (1885-6). In December, 1891, Prof. Dewar made a highly interesting communication to the Royal Society. On the occasion of the celebration at the Royal Institution of the centenary of Faraday's birth he gave several beautiful illustrations of the peculiarities of liquid oxygen, and he subsequently experimented with a view to ascertain its behaviour in the magnetic field. He had previously discovered that liquid oxygen did not moisten rock crystal, and consequently maintained a perfect spheroidal state when in contact with that substance. Some liquid oxygen, at a temperature of −180°C., was placed in a shallow cup of rock crystal and

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placed between the poles of Faraday's historic electromagnet. On the magnet being excited the whole mass of liquid adhered to the poles, showing that oxygen, which is only feebly magnetic at ordinary temperatures, becomes at −180°C. highly susceptible to magnetism.

DOBSON, Sydney Thornton, Assoc.M.I.C.E., M.I.E.E. Born in London 1866, educated at St. Paul's College, Stoney Stratford, and King's College School, London.

Mr. Dobson after a twelve months' technical training entered the service of Messrs. Edmunds and Goolden as an improver, and was engaged for some time on installation work, and in running the Hochhausen plant exhibited by that firm at the Health Exhibition. In September, 1884, he apprenticed himself to Messrs. R. E. Crompton and Co., passing through the various departments, and being occupied during the latter portion of his time in carrying out experimental work under Mr. James Swinburne. In March, 1887, he was sent by Messrs. Crompton to their installation at the Tilbury Docks, where he acted as second engineer. In September, 1887, he left for Vienna to take up a position on the electrical staff of the Imperial Continental Gas Association, and as senior assistant had charge of the large central station employed in lighting the Court Theatres. This station at the time was the largest example of supply by means of low-pressure currents and storage batteries, the distribution being effected on a four-wire system. In September, 1889, Mr. Dobson resigned his position on this Association, and returned to England to take up his appointment as chief engineer to the St. James's and Pall Mall Electric Light Company (Limited), where his work has met with most successful results.

DOLBEAR, Prof. Amos Emerson, was born in Norwich, Conn., U.S.A., in the year 1837.

At the beginning of 1854 young Dolbear was put to work in the pistol factory of Allen and Thurber, at Worcester, Mass. While he was at work in the pistol shop, Dolbear began his first experiments in electricity and magnetism. From Worcester he went to Missouri, where for four years he taught school, and then entered Mason's Locomotive Works at Taunton, Mass. While there he constructed a magneto-electric machine. In 1863 he went to work in the Armoury at Springfield, Mass., and fitted himself for college by study out of work hours. Thence he entered the Ohio Wesleyan College, at Delaware, Ohio, and was graduated in 1866. While an undergraduate he invented a magneto-electric telegraph, in which the current of electricity was generated by the action of a permanent magnet when thrust into or withdrawn from a hollow bobbin. This was designed to move a needle. He also proposed to have a like instrument at the receiving station, which he supposed would duplicate the movements of the first instrument. The receiving magnet was to be furnished with a pen, and thus register the movements of the transmitting one. He saw that the movements of the second would of necessity be precisely like those of the first, but did not at that time know that the movement of the second would be so feeble as it actually is. The year 1867 was spent by Dolbear as a student at the University of Ann Arbor, Mich. He graduated as Mining Engineer at Michigan University in 1867. After his graduation, Dolbear became Professor of Natural Science in West Virginia until 1874, when he received the appointment as Professor of Physics, at Tufts College, College Hill, Mass., where he has been located ever since. During the years 1867-74 he continued his experiments in electrical science. He, for example, discovered the convertibility of sound vibrations into electricity. Using a tuning-fork in connection with a thermo-pile and galvanometer, he noticed that when the fork vibrated the needle was deflected. He further observed the effect of a vibrating tuning-fork, which was also a magnet, upon the current from a thermo-pile. At the Portland meeting of the American Association, in 1873, Dolbear read a short Paper in regard to the first of these experiments, which he thought was new, but said nothing about the second, as he deemed it only a particular case of magneto-currents which were well known. It was in 1876 that Prof. Dolbear began his experiments in telephony, using at first a Helmholtz interrupter and electro-magnets. He now thought (December, 1876) of obtaining a patent upon his speaking telephone with permanent magnets, which he had invented in September, 1876; but before he had completed his patent model he was informed that Prof. A. Graham Bell "had declared that he had secured a patent upon the same thing two or three years before." In 1879 Professor Dolbear perfected an entirely new (static) system of telephony, which was patented in 1881. Prof. Dolbear's contributions to the scientific press have been numerous and interesting.

DOUBRAVA, Stefan. Born in 1857 at Brünn (Austria), graduate of the Universities of Prague and Vienna.

Doubrava in 1881 graduated as Doctor of Mathematics and Physics at the University of Prague, and in 1883 became Lecturer in Electricity. In 1884 he commenced as an electrical engineer, and in 1886 he entered the establishment of Robert Bartelmus in Brünn as partner. His first works "On the Identity of the Two Electricities," "The Electrical Perforation of Glass," "On the Movement of Plates between the Electrodes of a Holtz Machine," and on "Vortex Motions," were published among the Proceedings of the Vienna Academy. In 1885 he constructed an arc lamp, depending simply on the action of electro-magnets and solenoids without weights and gear wheels. At the Paris Exhibition this received a gold medal (with the firm Steinber and Co., Mulhausen). He has published in the German and English technical press a series of articles on dynamos, arc lamps, the production of sparks, the transformation of continuous currents by means of condensers, on condenser effects, electric light stations, the action of electro-magnets, &c.

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DOWN, F. J. Born at Bristol, and educated at Sandicroft College, Cheshire.

Mr. Down went from school to Glasgow as apprentice to A. and W. Smith, general engineers; and afterwards studied physics, chemistry, &c., with the celebrated Prof. Fresenius, at Wiesbaden, Nassau. Returning to England, he joined the staff of Messrs. C. Tennant and Co., chemical manufacturers, and afterwards the Blaydon Chemical Company, to carry out several new chemical processes being introduced there, and subsequently joined the Silicate Paint Company, of Charlton, to introduce there and erect the plant for a new sulphide of barium process, which is largely used for making their non-poisonous paints. After the appointment of Messrs. Laing and Wharton as agents of the original Swan Company he joined this firm, now known as Laing, Wharton and Down, who, as electric light engineers and contractors, have already successfully carried out several hundred electric-light installations. They it was who brought from America the celebrated Thomson-Houston system of electric lighting, now so largely used, and which was chosen for lighting the Eastern Division of the City of London. This system created great interest at the Inventions Exhibition, 1885, and was exclusively employed in lighting the American Exhibition of 1887, the Italian Exhibition, 1888, and the Military Exhibition, 1890.

DRESING, Peter Christian, M.I.E.E. Born at Aalborg, in Jutland, Denmark, October 21, 1852, and educated at the Cathedral Grammar School, Aalborg.

After serving an apprenticeship in pharmaceutical chemistry Mr. Dresing came to England in 1871, and entered the service of the Great Northern Telegraph Company, in whose employ he has remained ever since. In 1873 he was appointed on a special staff, which, under Capt. Hoskiær, superintended the manufacture and laying of about 1,000 nautical miles of submarine telegraph cable for the above-named company, the contractor being Mr. W. T. Henley, of North Woolwich. Mr. Dresing went to China in 1874, with 70 nautical miles of different types of heavy spare cable, and after his return to England he was appointed electrician at the company's Aberdeen Station, where he remained from 1875 to 1879, with the exception of two or three months of each winter, which he spent on cable repairs in the North Sea, thus acquiring a great amount of practical knowledge of submarine cable work. In 1879 Mr. Dresing was promoted as engineer and electrician to the company, and attached to the London office, and in 1883 he superintended the manufacture and laying of 1,300 nautical miles of duplicate cable for the company's system in Chinese and Japanese waters, and undertook a special tour of inspection of the Company's stations in the Far East. After his return to Europe he was appointed at the company's head office in Copenhagen, where he now holds the post of the company's superintending engineer. In 1890 and 1891 he superintended the manufacture and laying of the Company's two new North Sea cables—the duplicate Anglo-Swedish and Franco-Danish cables respectively—of a total length of about 900 knots. Mr. Dresing has been the instructor of most of the company's electricians, and he superintends the technical education of the younger members of the staff. He was elected an Associate of the Society of Telegraph-Engineers (now the Institution of Electrical Engineers) in 1875, in 1880 he was made a Member, and in 1890 he was appointed Local Hon. Secretary for Denmark. Mr. Dresing published a "New Formula for Calculating the Copper Resistance during Electric Disturbances (Earth Currents)," in 1877; in the following year a Paper on "Earth Currents;" and in 1891 a Paper "On the Induction in Multiple Core Cables."

DU BOIS, H. E. J. G., Ph.D. (Strasburg). Born in Velp (Holland), in 1863. Educated at the Polytechnic School, Delft, and at the Universities of Glasgow, Strasburg and Berlin.

After having passed through the higher preparatory municipal school of the Hague, Dr. du Bois studied mechanical engineering at the Polytechnic School of Delft. He there worked in Prof. Bosscha's physical laboratory, chiefly in electricity, the applications of which were then (1881-83) developing with great rapidity. He was also practically employed in an engine works for a short time. In order to pursue the subject at one of its chief sources, he went to Glasgow University, where he worked in the physical laboratory for 15 months, mainly occupied with working out new electrical appliances under Lord Kelvin's (then Sir William Thomson's) direction, at the same time, however, obtaining a nearer insight into the particular character of British science than would otherwise have been possible for him. In 1885 he went to Strasburg University to pursue his studies and work in the new Physical Institute under Prof. Kundt. In 1887 he graduated in physics, mathematics and chemistry, with a dissertation on "Magnetic Circular Polarisation in Cobalt and Nickel"; he afterwards carried out investigations on Kerr's Phenomenon, diamagnetism and kindred subjects. Prof. Kundt having been appointed to the Chair of Experimental Physics of Berlin University in 1888, Dr. du Bois remained in Strasburg under his successor, Prof. F. Kohlrausch, until the end of 1889, when he followed his former teacher to the German Metropolis. There he has since been working in the University Physical Institute at various subjects, chiefly electromagnetic or optical, and superintending the experimental work of part of the advanced students. He has published a series of contributions on the theory of Magnetic Circuits, forming the basis of a work on that subject just published. He was appointed a "Privat Docent" in Berlin University in 1892. He has also directed his attention to the construction of apparatus of a scientific and practical character. He is a Fellow of the Glasgow University Physical Society, a member of the Berlin Physikalische Gesellschaft and Elektrotechnischer Verein. He has published over a dozen Papers in addition to his dissertation.

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DU BOIS-REYMOND, Emil, Professor of Physiology at the Berlin University, Secretary to the Royal Prussian Academy of Sciences, F.R.S., &c. Born at Berlin in 1818.

By his father he is of Swiss origin, by his mother of Huguenot descent. He was educated partly at the French College of his native town, partly at the College of Neuchâtel, in Switzerland. In 1837 he entered upon the study of natural science at the Berlin University, and pursued it at Bonn during the summer session of 1838, but returning to Berlin exchanged it for medical studies in the autumn of 1839. As a medical student he became a pupil of the illustrious anatomist and physiologist, John Müller, who, in the spring of 1841, directed his attention towards animal electricity, and encouraged him to continue Galvani's, Nobili's, and Matteucci's work. In 1843, after publishing a preliminary account of his discoveries, including the true law of the muscular current, its negative variation during contraction, and of the nervous current, he graduated Doctor of Medicine, and in 1846 was admitted as Privat-docent in the medical faculty of the University. In 1845 he became one of the founders of that nursery of physical science, the Berlin Physical Society, of which he still is honorary president. In the meanwhile he had carried on his researches in animal electricity, and in 1848 and 1849 he published the two first volumes of his large work on that subject, the third and concluding volume of which appeared in two instalments in 1860 and 1884. In recognition of the value of that publication, he was in 1851 elected a member of the Berlin Academy of Sciences. Baron Humboldt gave notice to the Académie des Sciences of Du Bois-Reymond's experiment on the negative variation of the muscular current on the living human being; but Becquerel and Despretz having denied the fact, Du Bois-Reymond went to Paris in 1850 with his galvanometer of then unsurpassed sensitiveness, and a report by Pouillet settled the matter in his favour. In 1851 Dr. Bence Jones, of London, went over to Berlin to see Du Bois-Reymond's experiments, and invited him to come to London to show them at the Royal Institution, where Faraday took great interest in them; and in 1855 Du Bois-Reymond was invited to come over a second time to lecture at the Institution. Eleven years later, in 1866, he came over a third time, lectured at the Institution, and gave a Friday evening lecture "On the Time Required for the Transmission of Volition and Sensation through the Nerves," when he demonstrated with his spring myographion Helmholtz's fundamental experiment. In 1858 John Muller died, and although Du Bois-Reymond up to that time had not had the opportunity of distinguishing himself as a university lecturer, he was appointed his successor, and since then he has filled the first chair of physiology in Germany, and a great many professors of the new generation have been his pupils. A magnificent laboratory was erected in Berlin under his superintendence, and there he is still teaching the science to which he has devoted his life. He has also succeeded Müller as the editor of the *Archiv für Physiologie*. A collection of his numerous papers on the general physiology of muscle and nerve, and on the electrical organs of fishes, appeared in two volumes in 1875 and 1877. Many of his experimental contrivances are in use in the physical and physiological laboratories for research and for demonstration—the sliding inductorium, the current-key, the rheochord, the compensator, the aperiodic magnet, the muscular telegraph and alarum, the frog-interrupter, &c. In May, 1855, he showed at the Royal Institution the most delicate experiments on animal electricity—*i.e.*, the negative variation of the nervous current during action—by means of a beam of electric light reflected from a mirror connected with the astatic system of the galvanometer. In 1867 Du Bois-Reymond was appointed one of the secretaries of the Academy. He also twice, in 1870-71 and 1882-83, filled the office of a rector of the University. In these positions he has delivered a number of addresses, which were collected in two volumes in 1886 and 1887. He also, in 1872, gave a discourse at the meeting of the German Association of Scientists and Physicians at Leipzig, "On the Limits of Natural Knowledge," which has received much attention, and has gone through many editions.

DVOŘAK, Vincenz. Born in Dusejov, Bohemia, in 1848. Visited in 1866 the University of Prague, where, in 1871, he became assistant to Prof. Mach, and Lecturer for Physics in 1874. In 1875 he was called to the University in Agram as Professor.

His first work related chiefly to optics and acoustics. Several of his experiments concerning acoustic attraction and repulsion, continued since the year 1875, led him to investigate the analogies between sound waves and electrical and magnetic phenomena. Similar experiments of Bjerknes, exhibited by the latter at the Paris Electrical Exhibition in 1881, and those of Stroh, shown at the Society of Telegraph-Engineers in London in 1882, excited the greatest interest among scientific men, although they had as yet not found any application for practical purposes. At the opening of the Vienna Exhibition in 1883 Mr. Dvorák was requested to exhibit the apparatus which he had just completed for the purpose of further experiments, and it was brought before the scientific world in a lecture delivered before the Austrian Society of Electricians in Vienna, and published in the *Zeitschrift des Elektrotechnischen Vereins*, 1884, Vol. II. Prof. S. P. Thompson also described those experiments relating to acoustics in *Nature* of February, 1884. Mr. W. H. Preece, who interested himself in the apparatus, took a part of it to London and exhibited it before the Royal Society and the Society of Telegraph-Engineers. The experiments were intended to prove that the most varied phenomena of attraction—repulsion and current—could be imitated simply by means of vibrations of air. The theory that electricity and magnetism are only a peculiar vibratory condition

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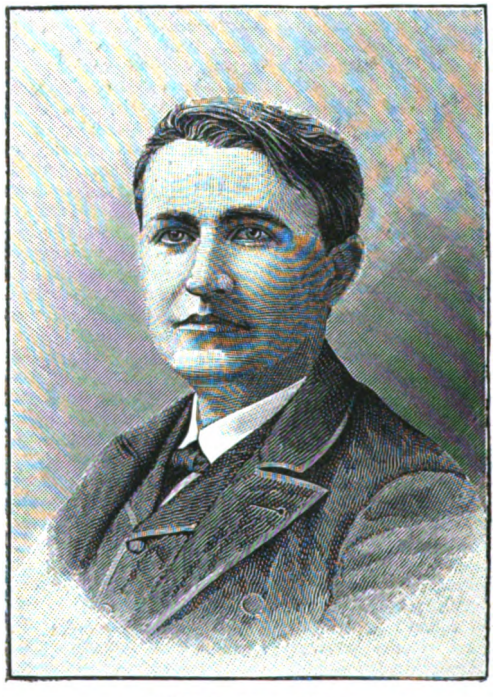

THOMAS ALVA EDISON.

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of some medium would thus gain strength by analogy with mechanical illustrations. He also proved that the hitherto generally accepted opinion concerning the electrostatic action of flames is not tenable. In 1889 he wrote "Ueber die Wirkung der Selbstinduction bei elektromagnetischen Stromunterbrechern" (Academy of Vienna).

EDISON, Thomas Alva. Born on February 11, 1847, at Milan, Erie Co., Ohio.

Without a regular school education, and largely indebted to his mother for his early instruction, young Edison achieved his own education. At twelve years of age he became a train boy on the Grand Trunk Railway, after which he became a newsvendor on his own account, employing four boy assistants. Becoming acquainted with the clerks in the telegraph office at Detroit, his attention was called to that department, and he worked so hard to make himself perfect in it, often practising the whole of the night, that his proficiency procured him in five weeks an appointment in the telegraph station at Port Huron. After serving in various telegraph offices he invented the first perfect automatic repeater. In 1864 he removed to Memphis, when the automatic repeater was put into service. He then devoted himself to the study of duplex transmission. When the Government of the United States gave up the wires to the Telegraph Company Edison was discharged, and he transferred himself to the telegraph office at Louisville, where he published a treatise of his own composition on electricity. His propensity to experimentalise cost him his situation, as he one day contrived to overturn a carboy of sulphuric acid, which occasioned some damage to the offices. In 1868 he was appointed to a post in Boston, where, in the head official, he found at last a man who appreciated his value. Edison opened at the same time a workshop, where he put many of his designs into practical shape. Improvements in electric telegraphy henceforth gained him much fame and wealth. He originated a dial instrument for the use of private lines, several of which he set going. He completed his first "private line printer," and put eight of them into active service. The Western Union Telegraph Company soon afterwards entered into an arrangement with Edison, at a high salary, and his improvements quickly superseded the existing apparatus, and are still in operation. His electrical laboratories at Newark, where he employed three hundred men, procured him the opportunity of bringing out many of his patents, and it may be stated that at one time he was engaged in bringing out simultaneously no fewer than forty-five distinct inventions. The profits of the manufactory, together with the proceeds of patents, at that time amounted to £80,000, all of which was again expended on products of his genius. In 1876 he disposed of his plant, and removed to Menlo Park, N.J. In 1887, finding his works at Menlo Park to be too contracted for his requirements, he quitted them after erecting in Orange, N.J., what is probably the largest experimental laboratory of its kind in the world. He has also in operation several large factories in New York, Schenectady, N.Y., Newark, and Orange, N.J., engaged in the manufacture of his inventions. Mr. Edison has taken out about 750 patents, most of them in use, directed to numerous improvements in telegraphy, electro-metallurgy, electric lighting, and the electrical transmission of power. He has recently perfected the phonograph and kinetograph, and is directing a large field of operations at the Ogden (N.J.) mines in connection with his new magnetic ore separators.

EDMUNDS, Henry. Born in Halifax in 1853. He has been largely identified with the introduction and progress of electric lighting.

In 1877 he introduced the Jablochkoff and Werdermann electric candles into the United States, and the same year he returned to this country with the Wallace-Farmer dynamo and plate lamp, the first arc lamp run in series with continuous current. In 1878 he introduced Edison's phonograph into this country, the first one made here being constructed by Mr. Augustus Stroh under his directions. About the same time Mr. Edmunds invented the "Phonoscope," an instrument showing the vibrations of sound in rays of light. He also invented an apparatus for signalling under water, which he termed the "Aquaphone." In 1878 he assisted in the formation of the Anglo-American Electric Light Company for the development of the Farmer-Wallace system. In 1379 this company deputed him to inquire into other American patents, the result being the acquisition of the patents of Mr. Brush and the formation of the Anglo-American (Brush) Electric Light Corporation. In 1880 Mr. Edmunds became interested with Mr. J. W. Swan in his incandescence lamp, and gave the first exhibition of the new illuminant in London at the *soirée* of the Royal Academy. He installed the new light upon the "City of Richmond," the first ship in the world to be lighted by incandescence, and introduced this system into the British Navy by the lighting up of H.M.S. "Inflexible." At the Paris Exhibition of Electricity he took charge of the Swan exhibit, and later on he lighted up the Grand Opera House. The next year he visited the United States, to introduce the Swan lamp into that country, and he assisted the Brush-Swan Electric Light Company in the development of electric lighting there. On his return he exhibited the Hochhausen arc light at the Fisheries Exhibition of 1883, at South Kensington, and showed a mast-light of six lamps. This method of illuminating large open spaces, although already employed in America, was then quite unknown in this country, and it created a great sensation. Mr. Edmunds had always taken great interest in the distribution of electricity by accumulators, and gained considerable experience with them in America. The difficulties connected with their use on a large scale induced him to devise a system of his own, and he read a paper on this subject before the Society of Telegraph-Engineers in the latter part of 1888. In the same year he brought over from America the Tainter Grapho-

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phone, which was exhibited at the British Association, the Society of Arts, and other places. and excited great interest owing to its marked improvement upon the performance of the first phonograph of Edison. During the last seven years Mr. Edmunds was a partner in the well-known firm of Walter T. Glover and Co. Owing to the illness of Mr. Glover in 1891, the sole responsibility of the business devolved upon Mr. Edmunds, who has since become sole proprietor. He has devoted himself to the improvement of conductors for electrical purposes, and has taken out severla patents for the same.

EGGINGTON, A. Born in Lichfield, Staffordshire, January 26, 1841.

Mr. Eggington entered the Telegraph Service in 1857, in the Submarine Telegraph Company, and the Government service three years later, under an engagement to proceed to the Malacca Straits to work the Rangoon cable. He joined the first of the three large steamers chartered by Messrs. Siemens and Halske, the "Queen Victoria," which, after various minor disasters and delays, ran aground at Wilderness Point, under Mount Edgcumbe, and became a wreck. He then entered the United Kingdom Company, which was then fighting its powerful rivals, the Electric and Magnetic Companies; and in 1861 accepted an appointment under Messrs. Glass, Elliott and Co. to proceed to Italy, to supervise the transit of the English telegrams to and from the East. In 1862 he was appointed to Bengasi Station (Barbary), and after four years in Africa he returned to Italy. In 1868 he was clerk in charge of the Turin office of the Susa-Modica line, belonging to the Telegraph Construction and Maintenance Company, and remained there until appointed by the new Société du Cable Française as office superintendent at Brest. He returned to Italy, Christmas, 1869, to become general superintendent of the above-mentioned Susa-Modica line.

Since that time he has always represented the Anglo-Mediterranean Company, which was fused with other companies in the Eastern Telegraph Company, in Italy, his headquarters being now at Rome. As representative of the Eastern he has to look after the many cables belonging to that company in Italian waters. At the Turin Exhibition the King of Italy was especially complimentary, and the jury awarded the Eastern Telegraph Company the highest possible honour, namely, the *diploma d'onore*. King Humbert some years ago conferred upon Mr. Eggington the Cross of the Crown of Italy and the title of Chevalier, and in 1887 he was promoted to a higher grade of the same Order. He designed some years ago a multiple-wired automatic lightning guard, which has proved very useful in cable huts; it is used on some of the Eastern Company's lines, and in two of the Italian Government Stations. This lightning guard was exhibited at an early meeting of the Society of Telegraph-Engineers. Mr. Eggington has been a contributor to the Italian scientific periodical, *L'Elettricista*, later on re-named *La Natura*.

ESSON, W. B. Born in Aberdeen, March, 1858.

At the age of fifteen Mr. Esson entered the engineering works of Messrs. Wm. McKinnon and Company, of Aberdeen, as an apprentice, leaving this firm three years later to attend the lectures on engineering at the Royal School of Mines. At this school he obtained the highest position in Applied Mechanics, and on finishing his studies entered a marine engineering works as draughtsman. In 1878 he entered the service of the Thames Iron Works and Shipbuilding Company, Blackwall, taking charge while there of the designing in the mechanical engineering department. Amongst other things Mr. Esson designed the paying-out gear and equipment for several cable ships, and it was here in 1881 that, while carrying out experiments for Mr. A. F. Hills, the managing director, his attention was turned to the subject of electric lighting. He had at the Thames Iron Works every opportunity of experimenting with the then best-known dynamos and lamps, and with a view to obtaining as thorough a knowledge of machines as then existed, he attended at the same time Prof. Ayrton's lectures at Finsbury Technical College. In 1883 Mr. Esson obtained at this College the second place in Electrical Instrument Making, and in the same year the silver medal of the City and Guilds of London Institute, in the Honours Grade of Electric Lighting and Transmission of Power. In August, 1883, he entered the firm of Messrs. Paterson and Cooper, as chief electrician, twelve months later becoming manager also. Mr. Esson retained this position until 1892, when he left to undertake the management of the Gülcher Electric Light and Power Company, Limited. The central stations for Wellington and Christchurch, New Zealand, are being equipped with plant constructed to his designs. He is well known in connection with the development of electric lighting, having made from time to time important contributions to the literature of the dynamo, which have appeared in *The Electrician* and other technical journals. He is amongst the engineers who took up electric lighting in this country when it was beginning to be recognised as having a future before it, and has worked with untiring energy to make this future a brilliant one. Mr. Esson is a member of the council of the Institution of Electrical Engineers, and to his Paper, "Some Points on Dynamo and Motor Designs," was awarded in 1890 the Premium of the Institution. He is also an Associate Member of the Institution of Civil Engineers, and served on the Jury of the Crystal Palace Electrical Exhibition in 1892.

EVERSHED, Sydney. Born in 1857; was educated privately, and has never passed an examination, nor even attempted to do so. He gained no prizes at school, and has never held a scholarship.

Having early shown mechanical tastes, he was apprenticed, in 1876, to a London optician, but his health failing at the end of the first year, he spent the next seven years in a manu-

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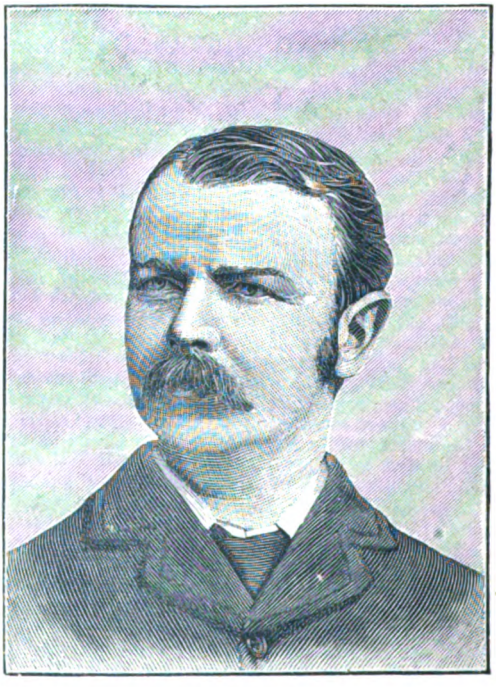

J. A. EWING.

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factory then just started near Guildford. Becoming manager in 1879, he was engaged in designing and constructing the whole of the new machinery and plant required in the development of the business. During this period he continued his electrical studies, and carried out a lengthy series of observations on atmospheric electricity. Among other work done at this time may be mentioned a research on the potential difference due to contact. In 1884 he resigned his position as manager in order to devote himself entirely to electrical work, and at the latter end of the year entered the instrument department of the Hammond Electric Light Company, where he remained until the liquidation of the company. After devoting the greater part of the next year to the development of the measuring instruments with which his name is associated, in 1886 he became manager of Messrs. Goolden and Trotter's instrument factory, and he still holds this position under the present firm. He is an Associate Member of the Institute of Electrical Engineers. He is an occasional contributor to the technical journals, and is understood to be engaged on an exhaustive "History of Self-Induction, from the time of Thales down to Dr. Fleming."

EWING, J. A., Hon. M.A. (Camb.), B.Sc. (Edin.), F.R.S., F.R.S.E., M.Inst.C.E. Born at Dundee, March 27, 1855; educated at the University of Edinburgh, where he graduated in Science.

Mr. Ewing became assistant in 1872 to Sir William Thomson and the late Prof. Fleeming Jenkin in telegraph engineering and other work, and took part in the Western and Brazilian, Platino-Brazileira, and other cable expeditions on their behalf. He was appointed in 1878 to the Professorship of Mechanical Engineering at the University of Tokio, Japan, which he resigned in 1883 to become Professor of Engineering at University College, Dundee. In November, 1890, he was elected to the Professorship of Applied Mechanics and Mechanism in the University of Cambridge—a post which he now holds. Prof. Ewing is the author of a large number of Papers on electrical and other scientific and engineering subjects. His earliest research was conducted in Prof. Tait's laboratory in 1872-3, with a fellow-student (now Prof. J. G. MacGregor), "On the Electrical Conductivity of certain Saline Solutions," and was published in the Edinburgh Royal Society's *Transactions* in 1873. This was followed in 1877 by a Paper in the *Phil. Trans.* describing the result of experiments "On Friction at Slow Speeds," by Profs. Fleeming Jenkin and Ewing conjointly. When the invention of Mr. Edison's phonograph was announced, Prof. Ewing (again in conjunction with Prof. Fleeming Jenkin) took advantage of it to perform an extensive series of experiments "On the Harmonic Analysis of Vowel Sounds," the results of which were published by the Royal Society of Edinburgh in their *Transactions* for 1878. During his residence in Japan he devoted much attention to the scientific examination of earthquakes, and designed instruments by which it became practicable to make absolute measurements of earthquake motion. These instruments and the conclusions which have been established by observations made with them are described in papers in the *Transactions* of the Seismological Society of Japan, the *Proceedings* of the Royal Society, and *Nature*, and also in his "Memoir on Earthquake Measurement" published by the University of Tokio, 1833. Prof. Ewing's seismographs have been adopted as standard instruments for the registration of earthquakes at a number of observatories, and have also been applied to measure the stiffness of engineering structures (*Proc.* Roy. Soc., 1888). From time to time during the last ten years he has communicated to the Royal Society the results of an elaborate series of experimental researches in magnetism and thermo-electricity. One of the facts brought out in his earliest magnetic Paper is that soft iron, contrary to previously-received notions, retains more magnetism when left completely undisturbed, after the inducing force is withdrawn, than steel or any other known substance. The term "hysteresis," introduced by Prof. Ewing to describe certain effects connected with retentiveness, is now a generally accepted addition to the electrician's vocabulary. The experiments are described in the following Papers published in the *Philosophical Transactions*—"Experimental Researches in Magnetism" (1885), "Effects of Stress and Magnetisation on the Thermoelectric Quality of Metals" (1886), "Magnetic Qualities of Nickel" (1888). A more recent research on the "Magnetisation of Iron in Strong Fields" (*Proc.* Roy. Soc. and B. A. *Report*, 1887, and *Phil. Trans.*, 1889) has shown that iron is capable of a far higher degree of magnetisation than was believed possible; and another on "Time-Lag in the Magnetisation of Iron" (*Proc.* Roy. Soc., 1889) has described the sluggishness which soft iron shows in responding to changes of magnetic force. Another Paper in the *Phil. Trans.* for 1893 describes a further series of experiments on the "Magnetic Qualities of Iron," made in conjunction with Miss H. G. Klaassen, which relate specially to measurements of the expenditure of energy in magnetic reversals. Other Papers are ("On Certain Effects of Stress in Soft Iron" *Proc.* Roy. Soc., 1881); "On the Production of Transient Electric Currents" (*Proc.* Roy. Soc. 1883); "On the Influence of a Plane of Transverse Section on the Magnetic Permeability of Iron" (B. A. *Report*, 1887; *Phil. Mag.*, Sept., 1888); "On the Magnetisation of Manganese Steel" (B. A. *Report*, 1887); "On Hysteresis, &c., in Transformer Cores" (*The Electrician*, April, 1892); "On Joints in Magnetic Circuits" (*Phil. Mag.*, 1892). Amongst Prof. Ewing's contributions to the subject of Magnetism is a molecular theory (*Proc.* Roy. Soc., June, 1890), which was explained at the Leeds (1890) meeting of the British Association by aid of a model, and attracted much attention. His treatise on "Magnetic Induction in Iron and other Metals" (1892)—one of the volumes of *The Electrician* Series of Standard Scientific Works—gives a connected account of much recent research

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bearing on the same subject. At the Edinburgh meeting of the British Association (1892), Prof. Ewing showed his "Magnetic Curve Tracer," an instrument which exhibits by the movement of a single mirror the relation of magnetisation to magnetising force in any magnetising process, and allows the magnetic qualities of samples of iron or steel to be tested completely and very simply. He was co-patentee with the late Prof. Jenkin of several inventions in general and electrical engineering. He is author of the articles "Steam Engine," "Strength of Materials," "Seismometer," "Sewerage," "Electric Traction," and others in the last edition of the *Encyclopædia Britannica*.

Dynamo," "Electric Light," and "Gas Engines" are among articles contributed by him to the revised issue of *Chambers' Encyclopædia*. He was elected a Fellow of the Royal Society in 1887.

FAURE, Camille A. Born at Vizille, in the mountains of Dauphiné, France, of an old family of peasant landowners.

Although M. Faure received some instruction at the professional school and at the Ecole des Arts et Métiers he must be considered as self-taught. From 1859 to 1872 he found successive and uninterrupted employment as mechanical draughtsman, or in superintending the erection of metal works, at sixteen different large establishments in the South of France, Paris, and England; in the latter country he was for three years managing draughtsman at De Bergue and Co.'s. In 1859 he invented the "black bottle" nitric acid battery, manufactured by Elliott Brothers. In 1872 there is a record of his attempt at obtaining a secondary battery. The making and development of Faure is greatly due to his quiet and long stay with the Cotton Powder Company, whose works at Faversham, Kent, he erected for the manufacture of the explosive "tonite," well known and largely employed in this country. This is his invention, together with the distress signals almost exclusively used by the Board of Trade and the Mercantile navy. During this employment as chemical engineer from 1872 to 1880 he had large means and spare time for study and experiments, and he turned his attention to a great number of subjects. We find in the *Mining Journal* two or three very able communications by him on thermo-chemistry as applied to explosives. In 1878 he returned from a visit to the Paris Exhibition with the idea of his secondary battery well fixed in his mind, and within a month he had discovered spongy metallic lead obtained from insoluble oxides, and perceived its value as a material for negative plates, which was previously unknown. The battery was conceived; there remained the possible drawback of irremediable sulfatation. This was afterwards finally disposed of by obtaining a secondary battery out of elements made entirely of sulphate of lead. This battery completed, M. Faure, as a true inventor in spirit and in ignorance of business, ran immediately into new thoughts, leaving to others the commercial development of his invention. However, in 1882 he improved his battery by perforating the plates and alloying the lead of the supports with antimony. The Patent Office is well acquainted with the work of M. Faure in various directions, and particularly in his attempts to utilise electricity in the manufacture of aluminium. A Paper by him "On the Manufacture of Aluminium Chloride in a very Novel and Economical Way" was read by M. Berthelot before the French Academy of Science in August, 1888. The practical way of electrolysing chloride of sodium has occupied M. Faure's thoughts since 1872. The enormous waste water power of Dauphiné has also attracted his attention, and he has brought out a scheme for utilising a fall of 20,000 H.P. A petroleum motor of M. Faure's invention, which possesses novel features, is also on the market.

FAWCUS, W. P. James, A.M.I.C.E.

Mr. Fawcus was educated at Wellington College and University College, London. He served his time as an engineer with Messrs. Bells, Lightfoot and Co., of Walker-on-Tyne, and in 1880 entered the service of the firm of J. and E. Hall, engineers, of Dartford. In 1881 he became assistant to Mr. T. B. Lightfoot, consulting engineer. In 1882 he joined the staff of Messrs. John I. Thornycroft and Co., torpedo boat builders, of Chiswick, as engineer, remaining with this firm until 1884. In 1885 Mr. Fawcus became assistant to Mr. Arthur Rigg, engineer, of London, for whom he organised and started works at Haggerston, and the Victoria Engine Works, Chester. Of the latter works he was appointed manager in 1886, which appointment he held until 1889. In 1888, in conjunction with Mr. Edw. W. Cowan, Mr. Fawcus formed the firm of Fawcus and Cowan, of Chester. This firm were appointed engineers to the Keswick Electric Light Company, and designed and carried out for them their central station, the first in the United Kingdom to be driven by water-power. In 1889 Mr. Fawcus was appointed manager to the Manchester Edison-Swan Company, and was elected managing director in 1890. Since his connection with this Company he has designed and carried out many large lighting installations and other engineering works at home and abroad, and has been associated in the design and construction of several central stations for both alternate and direct current, a class of work in which he has considerable experience. He is joint patentee of the Fawcus-Cowan slow-speed dynamo. He is the author of several Papers on engineering and allied subjects, two of which, written jointly with Mr. Cowan, on "A Light Draught Launch," and "The Keswick Water-power Central Station," were read before the Institution of Civil Engineers, and obtained a "Miller" prize and a "Manby" donation.

FERRARIS, GALILEO, Civil Engineer Doctor of Science, Principal and Professor of Technical Physics and Electrotechnics at the Royal Museo Industriale Italiano in Turin. Born in Livorno, Piedmont, Italy, in 1847; educated in Turin at the Royal

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Università and the Royal Scuola di Applicazione degli Ingegneri.

Galileo Ferraris was graduated Bachelor of Mathematics and Physics at the University of Turin in 1867, and civil engineer at the Royal Scuola di Applicazione degli Ingegneri di Torino in 1869. On that occasion he published a Paper on "The Telodynamic Transmission of Hirn," which was the first Paper on this subject printed in Italy. As soon as he left the University he was appointed assistant to Prof. G. Codazza, then Professor of Technical Physics at the Royal Museo Industriale Italiano; and since that time has devoted himself entirely to the study and teaching of physical science. In 1872 he was selected out of several candidates to fill the position of Dottor Aggregato in the Faculty of Mathematics, Physics, and Natural Science at the University of Turin, being at the same time elected member of the Academic body of the University, on which occasion he read a lengthy Paper on "The Mathematical Theory of the Propagation of Electricity through Homogeneous Bodies." In 1877 Prof. Ferraris took sole charge of the course on technical physics at the Royal Museo Industriale Italiano in Turin; and in 1879 a Royal decree elected him Principal and Professor of the Chair of Technical Physics at the same institution. At this time he devoted himself chiefly to geometrical optics, and to the scientific and practical developments of the applications of electricity and heat, and published in Turin in 1877 an important book, entitled "Le Proprietà Cardinali degli Strumenti Diottrici," which was translated into German by Prof. Lippich, of Prague, under the title, "Die Fundamental-Eigenschaften der Dioptrischen Instrumente." This book is widely read in Germany, where it has been adopted as a regular text-book in the schools. In 1880 Prof. Ferraris delivered before the Royal Accademia delle Scienze di Torino a memoir on "Telescopes having an Object Glass made up with Several Individual Lens at a Distance from each other," dealing with the peculiar properties of what is now known under the name of "Ferraris's Interstitial Determinant." In this memoir the theory of the anallatic telescope is extensively developed, and the invention of the shortened telescope is embodied. On electricity he has published several Papers, the most important ones dealing with the theory of the telephone. Among these is worth mentioning the memoir "On the Intensity of the Currents and Extra-Currents in the Telephone," which contains the results of one among the first measures on the current required to yield a perceptible sound in the telephone. (*See* "Atti dell' Accademia delle Scienze di Torino," 1878; *see also* G. Wiedemann's "Die Lehre von der Elektricität," Braunschweig, 1885, Vol. IV., p. 286.) The science of the technology of heat occupied the chief place in his regular course on Technical Physics to Engineers; and he has published on this subject a memoir, "On a Method for the Measure of the Water carried over Mechanically with Steam." (*See* the "Atti della Reale Accademia delle Scienze di Torino," 1881.)

In 1881 the International Electrical Exhibition at Paris, and the first International Electrical Congress held there, attracted the attention of Prof. Ferraris, as well as of many other physicists, towards electrotechnics, and urged him to devote himself mostly to this particular branch of applied physics, whose importance was growing every day. The Italian Government sent him as official delegate to this Congress, and to the International Conference on electric measurements held in 1882; and in 1883 he was appointed Italian Commissary to the Electric Exhibition in Vienna. In the following year he was the principal promoter and President of the International Electric Department in the General Italian Exhibition held in Turin. On that occasion Prof. Ferraris carried out his theoretical and experimental researches on the Gaulard and Gibbs transformers; these researches, as is well known, being amongst the earliest and most extensive on the scientific study of transformers. Prof. Ferraris, following this line of studies, made in 1885 several measurements on the Zipernowsky, Déry and Bláthy transformers of the close magnetic circuit type, and began to devote himself mainly to the study of the theory and application of alternating currents. He carried out, in August and September, 1885, his experiments on electrodynamic rotations by means of alternating currents; and he succeeded in demonstrating that it is possible to yield a rotating magnetic field by means of two alternating currents of the same period having a difference of phase, viz., how a uniform rotary movement can be generated with two alternating currents, and he constructed an alternating current motor which is asynchronous and does not need any commutator or collector. These results were given in a Paper delivered before the Royal Accademia delle Scienze di Torino on the 18th March, 1888 ("Atti della Reale Accademia di Torino," Vol. XXIII.), and have become widely known through the last developments of this class of apparatus. Prof. Ferraris carried out in 1886 a long theoretical and experimental research on alternating-current transformers, and he published his results in 1887 in the memoir, "On the Differences of the Phase of Currents, on the Lag of Induction, and on the Waste of Energy in Transformers," where was shown for the first time the relation existing between the difference of phase of the primary and secondary currents in a transformer, and the waste of energy due to hysteresis and eddy currents. The author has been able to draw from this relation a new method, which is made use of in this same series of experiments, for the measure of the energy delivered to the primary circuit by means of three electro-dynamometers. In 1886-87, Prof. Ferraris organised the Electrotechnic School for Engineers in Turin, which was the first of its kind to be opened in Italy. Later on this school was recognised as an official one by the authorities, and it is now supported by the Government. In 1889 an official commission was appointed from the Municipality of Frankfort-on-Main to make a series of experiments on alternating-current motors, and to answer several ques-

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tions relating to the electric plant to be installed for the lighting of the city, Prof. Ferraris being a member of this Commission. He was a member of the International Board of Measurements at the Frankfort Electrical Exhibition in 1891, and was one of the vice-presidents of the Electrical Congress held in connection with that Exhibition. He was also the official representative of the Italian Government in the Chamber of Delegates, and was one of the vice-presidents of the International Electrical Congress at Chicago in 1893. Prof. Ferraris is a member of the R. Accademia delle Scienze di Torino; a Fellow of the R. Accademia di Agricoltura, a national member of the R. Accademia dei Lincei in Rome, of the Societa Italiana delle Scienze, and a corresponding member of the R. Istituto Veneto di Scienze, Lettere ed Arti, &c.

FITZ-GERALD, Desmond G., M.I.E.E. Born Feb. 21, 1834.

Having a great taste for scientific pursuits, and a distaste for official routine, Mr. Fitz-Gerald gave up his appointment in the War Office towards the end of 1861 in order to start *The Electrician* (old series), which was the first journal in which electrical applications, and especially submarine telegraphy, were discussed and advocated. This paper, upon which his principal *collaborateurs* were Mr. Owen Rowland, Mr. Richard Laming, and Mr. F. C. Webb, was continued under many difficulties and discouragements until May, 1864. It did much to forward the persevering and ultimately most successful attempts to lay an electric cable across the Atlantic. After that period Mr. Fitz-Gerald wrote frequent articles in the *Mechanics' Magazine*, the *Engineer*, and the *Electric Telegraph Review*, which paper was for a considerable period under his editorship. The direction of the science classes at the School of Telegraphy and Electrical Engineering was in his hands from the commencement until a few years ago, and many of the foremost among the rising generation of electricians received their first technical instruction from his lectures. He was one of the original members of the Society which has developed into the Institution of Electrical Engineers. Mr. Fitz-Gerald has given particular attention to electro-chemistry, including the study of the various forms of primary and secondary batteries.

FITZGERALD, George Francis, F.R.S., &c. Born in Dublin in 1851.

Prof. FitzGerald was educated at home and at Trinity College, Dublin. He took a Science Scholarship in 1870, and a University Studentship in 1871, graduating as B.A. 1871, and M.A. 1874. He obtained a Fellowship of Trinity College, Dublin, in 1877, and was afterwards appointed Erasmus Smith's Professor of Natural and Experimental Philosophy in the University of Dublin, 1881. He was Hon. Sec. of the Royal Dublin Society from 1881 to 1889. He was elected F.R.S. in 1883. He was President of Section A, British Association Bath Meeting, in 1888, and in the same year was appointed Examiner in Experimental Science at the London University. Prof. FitzGerald has published Papers on Electro-magnetic Theory in the *Transactions* of the Royal Society and in the *Transactions* of the Royal Dublin Society, as well as in the *Proceedings* of these Societies.

FLEMING, John Ambrose, M.A. (Cantab.), D.Sc. (Lond.), F.R.S. Born in Lancaster, Nov. 29, 1849; educated at University College School, London, University College, the Royal School of Mines, and St. John's College, Cambridge.

After an education at University College School and in University College, London, Mr. Fleming graduated Bachelor of Science at the University of London in 1870. From 1873 to 1874 he was Demonstrator in the Laboratories of the Royal College of Chemistry and private assistant to Dr. Frankland; and in 1874 he was appointed Lecturer on Physics and Chemistry at Cheltenham College. In 1877 Mr. Fleming entered Cambridge with the special object of working under the late Prof. Clerk Maxwell in the Cavendish Laboratory, Cambridge, in which place he carried out a long research, at Prof. Maxwell's instigation, comparing the existing British Association standards of electrical resistance, with the object of determining their differences at different temperatures and determining the mean British Association ohm. At St. John's College he obtained the Entrance Natural Science Exhibition, and was made Foundation Scholar in 1879, and also successively Hare Exhibitioner, Wright's Prizeman, and Hughes's Prizeman, this last being a special prize annually awarded to the Foundation Scholar most distinguished in mathematics and natural philosophy. He graduated Doctor of Science in the University of London in 1879. After taking the Cambridge M.A. degree, a first class with special honours in the Natural Science Tripos, he was appointed Demonstrator in Mechanism and Applied Science to the University of Cambridge, under Prof. James Stuart, and lectured on mechanism in the mechanical workshops. When University College, Nottingham, was opened as the centre for university teaching and technical education, Dr. Fleming was selected out of a large number of candidates as the first occupant of the Chair of Mathematics and Physics, but resigned the professorship after a short tenure to remove to London. On the formation of the Edison Electric Light Company he was appointed acting electrician; and on the amalgamation of the Edison and Swan Companies retained the position of advising electrician to the united company, which position he has since held. In 1883 he was elected a Fellow of St. John's College, Cambridge, and in 1884 a Fellow of University College, London. He is the author of many papers, which have appeared in various *Transactions* during the last few years. He is a member of the Physical Society, of the Royal Institution, a member of the Council of the Institution of Electrical Engineers, and a member of the British Association Committee for Determining Electrical Standards. In 1885 he was appointed the first occupant of the Chair of Electrical Engineering newly created in University College. Since then he has organ-

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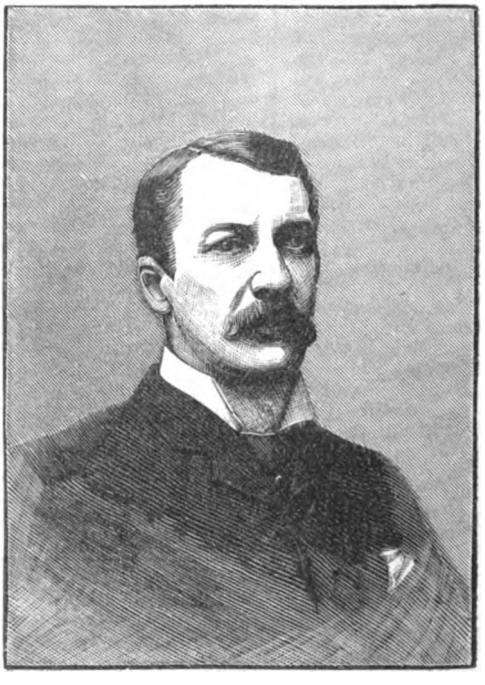

GEORGE FORBES.

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ised a department of practical electrical engineering in University College, so that the regular college courses on physics and engineering are supplemented by practical instruction in this branch of technology. He designed all the interior arrangements of the new Electrical Laboratories in University College, London. He has published a course of lectures, entitled "Short Lectures to Electrical Artizans," the basis of which was a course of practical lectures delivered to the *employés* at Messrs. R. E. Crompton's works, Chelmsford, which has passed through four editions, and been widely read. Between 1889 and 1891 he published the first and second volumes of a treatise on the "Alternate Current Transformer," which forms part of *The Electrician* Series of Scientific Publications, and which has run through many issues and become the standard treatise on the subject. In 1892 he was elected a Fellow of the Royal Society. He has frequently lectured at the Royal Institution and the Society of Arts, and has contributed many Papers to the *Transactions* of the Physical Society, Royal Society, Institution of Electrical Engineers, British Association, and other technical societies. In addition to holding the position of permanent scientific adviser to several corporations he practises as a consulting electrical engineer, and in this capacity acts as scientific adviser to many firms, corporations, and electrical companies in matters connected with patent investigations, arbitrations, and electrical expert work generally. As a lecturer he is well known, having given courses of Gilchrist and Cantor Lectures, and has taken a considerable practical interest in the subject of popular and technical education.

FORBES, Prof. George, is the son of James David Forbes, D.C.L., LL.D., F.R.S., &c., Professor of Natural Philosophy at Edinburgh University, and afterwards Principal of St. Andrew's University, who was son of Sir William Forbes, seventh baronet, of Pitsligo, the friend of Sir Walter Scott.

The subject of our sketch was educated at St. Andrew's and Cambridge Universities; at the former institution he twice won the Grey prize for essays on solar physics and on meteors and shooting stars, and at the latter he took degree with mathematical honours. After leaving Cambridge, Prof. Forbes spent a year in Prof. Tait's laboratory at Edinburgh. He was elected Professor of Natural Philosophy at Anderson's College, Glasgow, at the age of 23, and remained there from 1872 to 1880. In 1874 he went out in command of the Government expedition to Hawaii, to set up observatories, determine the longitude, and observe the transit of Venus; he went out by way of the Straits of Magellan, and after spending six months on the islands he returned by way of San Francisco, Japan, China, Siberia, and St. Petersburg. In 1877, during the long Scotch Vacation, he acted as special correspondent to *The Times* in the Russo-Turkish War, and was the only Englishman who gained access to the Russian camps in Asia. In 1881 he became manager of the British Electric Light Company, and worked the Gramme dynamo and Lane-Fox incandescent lamp, starting the first central station for electric light in London. In 1882 he commenced to practise as consulting engineer in Westminster. In addition to his travels mentioned above, Prof. Forbes has been much on the Continent, and has paid several visits to the United States. He is a Fellow of the Royal Society, of the Royal Society of Edinburgh, of the Royal Astronomical Society, and of the Allgemeine Astronomische Gesellschaft, a Vice-President of the Institution of Electrical Engineers, and is also a Member of the Institution of Civil Engineers, of the American Philosophical Society, and of the Société Internationale des Electriciens, and an Honorary Member of the Franklin Institute. In 1881 he was made a Chevalier of the Legion of Honour. He has acted as consulting engineer to several of the largest electric lighting companies in London and elsewhere, also to the Vestry of Paddington and other local authorities; and in May, 1892, was appointed consulting electrical engineer to the Cataract Construction Company of New York, formed for the purpose of utilising the water-power of the Falls of Niagara. Prof. Forbes' most important inventions include a fire-damp indicator; a dynamo for large currents; an electric current meter; carbon brushes for dynamos and motors; the ironclad dynamo, with the exciting coils round the armature instead of round the field magnets; an underground system of conductors; and a destructor for city refuse, suitable for obtaining steam power for the electric light. He has found time in the course of an extremely busy career to publish works on "The Transits of Venus," "Rendu's Theory of Glaciers," and reprinted "Lectures on Electricity"; and to contribute the following writings on electrical subjects (amongst many others) to the publications mentioned:—*B. A. Reports:* "On Certain Connections between the Molecular Properties of Metals" (1873), "On an Electrical Gyrostat" (1879), "On the Diameters of Wires Required for Different Electric Currents without Overheating," and "On a New Arc Lamp" (1882). *Proc. Royal Soc., Edin.:* "On Diamagnetic Rotation" and "On the Theory of the Telephone" (Vol. IX., 1875-1878), "On Transmission of Power by Alternate Currents' (1883). *Proc. Royal Soc.:* "A Sensitive Form of Thermopile" (1886) and "A New Telephone Transmitter" (1887). In the *Journal of the Society of Telegraph Engineers:* "On the Proper Dimensions of Wires to Carry Electric Currents without Overheating" (1884), "Remarks on a Paper by Mr. Kapp (1886), showing how to Calculate Magnetic Leakage in Dynamos," and "Some Electric Lighting Central Stations in Europe and their Lessons" (1889). *Journal of the Society of Arts:* "Electricity as a Motive Power" (1884), "Cantor Lectures on the Distribution of Electricity" (1885), "On the Distribution of Electricity" (1886), "Six Lectures on Electricity" (1887), "Cantor Lectures on Developments of Electrical Distribution "(1892). *Times:* Long series of Letters on the Paris Electrical Exhibition (1881). Prof. Forbes has, in addition, written many Papers on astronomical and cognate subjects.

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FRÖLICH, Oscar, Ph.D., was born in 1843, at Berne, Switzerland, and studied physics and mathematics at the Universities of Berne and Königsberg, Prussia, at which latter place he was pupil of Prof. F. E. Neumann, the author of "The Law of Electric Induction."

In 1868, Dr. Frölich was Privat docent at the University of Berne; from 1869 till 1873 he taught physics and mathematics at the Agricultural and Forest Academy of Hohenheim; in 1873 he entered the establishment of Siemens and Halske of Berlin, where he still holds the post of chief electrician and director of the laboratory. He has written a treatise on Electricity and Magnetism (a second edition of which was published in 1887), and "The Dynamo Machine, a Physical Description" (1886, French translation 1887). His principal Papers treat of the temperature of the earth, of the temperature of the interplanetary space, the variations of the heat of the sun, the theory of the dynamo machine, the universal Wheatstone Bridge, and optical demonstrations of the movement of the telephone, and of alternate-current waves.

FULLER, Thomas, F.R.G.S., was born in 1832, and was educated at Caius College, Cambridge.

Mr. Fuller is Managing Director of the Brazilian Submarine Telegraph and African Direct Telegraph Companies, and is a Director of the West African, the Pacific and European, and the Europe and Azores Telegraph Companies. Mr. Fuller is an Officer of the Brazilian Order of the Rose, and Commander of the Orders of Conception and Christ of Portugal.

GARCKE, Emile, was born in Germany in 1856, but has since been naturalised as a British subject.

Mr. Garcke commenced his business career at the age of 18, when he became assistant to the secretary of the London and Provincial Bank, and he has since been associated in various capacities with a number of industrial concerns in England and on the Continent, having had a very extensive experience in the administration of joint-stock companies. He became connected with the electrical industry in 1883, when he was appointed secretary of the Anglo-American Brush Electric Light Corporation. During the following ten years he was closely identified with the progress of the Brush Company, and it would be difficult to sketch his subsequent career without at the same time describing the history of that Company. In 1887 Mr. Garcke was appointed manager as well as secretary; and in January, 1891, he was appointed Managing Director. In 1892 he resigned this executive position, and was appointed to a seat on the Board. While with the Brush Co. he personally superintended their Continental business, and besides conducting the successful negotiations for the sale of their central station at Temesvar to the municipality, he directed the policy of the Vienna firm of Kremenezky, Mayer and Co., which now ranks as one of the leading electrical businesses in Austria. Last year he was offered the position of Managing Director of the Electric Construction Corporation, and upon accepting the same he resigned his seat at the Board of the Brush Company. Since his appointment the Electric Construction Corporation has been "re-constructed," and a complete reorganisation of the business has been carried out. Mr. Garcke has likewise been associated with other electrical movements. He was hon. secretary to Lord Thurlow's Electric Lighting Act Committee until the passing of the Amendment Act in 1888; and was instrumental with Mr. Crompton and others in forming the Electrical Section of the London Chamber of Commerce, of which he is now vice-chairman, and during the past year he organised the special Electric Traction Committee of the Chamber. The Committee prepared evidence submitted to the Joint Committee of both Houses of Parliament on the telephone question, and was instrumental in obtaining a very important amendment of the law in favour of electric traction. He is an original Director, and now Managing Director, of the Electric and General Investment Company, Director of the Chelsea Electricity Supply Company, of the Oxford Electric Company, of the Crystal Palace District Electric Supply Company, and of other electrical companies. He is a Fellow of the Royal Statistical Society, member of the Institute of Electrical Engineers, of the Institute of Actuaries, of the Society of Arts, and of other societies In conjunction with Mr. J. M. Fells he has written a book on "Factory Accounts; their Principles and Practice," which has been published both in England and in America, and has passed through several editions.

GARNETT, William.

Prof. Garnett was Demonstrator of Physics in the University of Cambridge during the tenure of the Professorship by the late Prof. James Clerk Maxwell, and was afterwards Lecturer on Physics in St. John's College, of which he was for some time a Fellow. He was subsequently Professor of Mathematics, Physics, and Mechanics in University College, Nottingham, and electrician to the Corporation of that borough. He was afterwards appointed Principal of the Durham College of Science, and whilst holding this appointment the new buildings of the College were provided with a very complete physical laboratory in which the electrical testing room is a special feature. As Chairman of the Electric Lighting Committee of the Royal Jubilee Exhibition at Newcastle-on-Tyne, of the Executive Council of which he was a member, he acted as hon. electrician to the Exhibition. In July, 1893, Principal Garnett was appointed Educational Adviser and Secretary to the Technical Educational Board of the London County Council, the committee to which the Council has delegated all its powers under the Technical Instructions Acts, and he is now engaged in endeavouring to organise a system of technical education for London which shall lead from the public elementary schools to the technical colleges and equip the students for industrial pursuits.

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EMILE GARCKE.

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GAVEY, John, M.I.E.E., was born in Jersey, August 11, 1842, educated at Victoria College, Jersey, and entered the service of the late Electric and International Telegraph Company in 1860.

In 1870, on the transfer of the telegraphs to the State, Mr. Gavey was appointed superintendent of the South-Eastern, and subsequently of the Great Western Sub-Division of the Southern Division of England, of which Mr. Preece was divisional engineer. In 1878 he became superintending engineer of the South Wales district of telegraphs, and in November, 1892, he was appointed Chief Technical Officer at the General Post Office, London. Mr. Gavey has contributed occasional Papers to the Society of Telegraph-Engineers, the Naturalists' Society of Cardiff, and to the professional journals. During a lengthy residence at Cardiff he took an active part in promoting the scientific and literary progress of the town, and served on the Free Library, Museum, and Technical Education Committees; but his principal work has been of a departmental character.

GEE, William Winson Haldane, B.Sc. (Lond.), F.C.S. Born near Bolton (Lancashire), 1857.

Mr. Haldane Gee was educated at the Manchester Grammar School, the Royal College of Science, and Owens College. He has held the position of Science Master at the Preston and Macclesfield Grammar Schools, and Science Lecturer at the Useful Knowledge Society, Macclesfield, the Harris Institute, Preston, and the Technical School, Manchester. In 1881 he was appointed Demonstrator in Physics at Owens College, Manchester, under the late Professor Balfour Stewart. In conjunction with Professor Stewart he has published three volumes on Practical Physics: Vol. I., "General Physical Processes" (1885), Vol. II., "Electricity and Magnetism" (1887), and Vol. I. of a "School Course of Practical Physics (Electricity and Magnetism)" (1888). He has published a number of original Papers relating to general and chemical physics, and is especially interested in the scientific and technical developments of electro-chemistry. He has taken part in the development of the teaching of practical physics, has designed a number of physical laboratories, and has for many years been engaged in teaching electrical technology. In June, 1891, he was appointed Chief Lecturer in Physics and Electrical Engineering at the Manchester Municipal Technical School. The Central Technical School in Princes-street being already overcrowded, it was decided to open a new branch of the School in a large warehouse in Whitworth-street, which has been fitted up for physical and electro-technical teaching. Already 300 day and evening students are attending the lectures or working in the laboratories, so that this new Electrical Engineering School promises to have an important relation to the electrical industries of Manchester and district. Mr. Gee is one of the Extension Lecturers of the Victoria University, and in this capacity has lectured on "Electricity and its Technical Applications" at various places. He has also lectured to the Fire Institute of Manchester and the Fire Association of Manchester on "Fire Risks of Electric Lighting."

GEIPEL, Wm., M.I.E.E. Born 1860; was educated at Bristol Grammar School and at the College of Physical Science, Newcastle-on-Tyne. He passed the Oxford Local Examination in 1876, and the City Guilds Examination in Electric Lighting and Engineering in 1882, in both of which he obtained first-class honours.

Mr. Geipel served a four years' apprenticeship in the workshops and drawing offices as a mechanical engineer, at the well-known marine engine works of Messrs. T. Richardson and Sons, of Hartlepool, and was also six months at Hebburn Collieries, county Durham, studying mining engineering. Subsequently he was with a firm of civil engineers in the City of London, by whom he was engaged on several important works, and whom he left to enter the service of the Anglo-American Brush Corporation in 1882. Shortly afterwards he was appointed assistant manager at their Dynamo Works in Borough-road. In 1884 he was sent by them to Edinburgh to superintend the lighting of the Forestry Exhibition, which was exclusively carried out by the Corporation under his supervision to the entire satisfaction of the committee. Subsequently, Mr. Geipel negotiated and carried out for the Brush Company a large number of electric light installations in England and Scotland, and opened branch offices in Edinburgh and Glasgow, which were under his charge, as the Company's superintendent for Scotland, up to 1889. Upon the formation of the Scottish Electric Supply Company Mr. Geipel became one of the Directors. In 1889, owing to the rapid development of their business in the lighting of towns, the Brush Company found it necessary to appoint a central station engineer, and selected Mr. Geipel for the post, in which capacity he had control of the designing, working, and equipment of the Brush Company's central stations in this and other countries. Upon the re-arrangement of the Brush Company's staff in 1892 he was appointed their superintending engineer, which appointment he still holds. For two years previous to his leaving Edinburgh he also held an appointment at the new Heriot-Watt College as lecturer in Electrical Engineering. Mr. Geipel is an occasional contributor to the columns of *The Electrician*, and at the annual meeting of the Institution of Mechanical Engineers in London, 1888, read a Paper on "The Position and Prospects of Electricity as Applied to Engineering," which was published in the leading electrical and engineering journals in this and other countries. He is one of the authors of Geipel and Kilgour's "Electrical Engineering Formulæ," one of *The Electrician* Series of Standard Scientific Works.

GENT, John Thos. Born at Leicester, 1841.

Served an apprenticeship with a mechanician of the same town, and soon afterwards entered the service of Mr. Smeeton, electrical con-

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tractor, of Halifax, Yorkshire. In 1864 he became private electrical assistant to Mr. L. J. Crossley, of Willow Hall, Halifax, remaining there nearly two years, and after leaving Mr. Crossley commenced business in Halifax, shortly afterwards joining in partnership with Mr. Blakey, of the present firm of Blakey, Emmott and Co. After dissolving partnership with Mr. Blakey he came to Leicester and entered into business as a wholesale electrician. He published a "Manual of Electric Bell Fixing," which had a large sale and did much to popularise this branch of the trade. When electric bells for domestic purposes came before the public in a practical form, Mr. Gent was one of the very few who pioneered what has since become an enormous and profitable business. He invented a new system of "drop" indicators, and shortly afterwards introduced a novelty in electro-pneumatic bells, followed by an entirely new system of mechanical pneumatic bells, all of which he protected by patents. In 1875 he introduced the "knife-edge" form of swinging pendulum signals, which has since been almost universally adopted. Shortly afterwards he invented a watchman's clock, which received the approval of Her Majesty's Commissioners in Lunacy, and has been adopted in many of the largest asylums in the country. In 1881 he brought out and patented an excellent combined microphone and telephone, which promised a large sale, but owing to the action of the United Telephone Company its manufacture had to be abandoned. Since the expiry of the Edison patent, however, it has been resumed with remarkable success. Within a recent period, Mr. Gent has, in conjunction with his partners, taken out several important patents, amongst them being a watchman's clock, marking in fluid ink, also an "electrical fire-damp detector" for mines, which is portable, and will automatically indicate as little as a half per cent. of gas, and which has been highly reported upon by mining experts.

GERARD, Eric. Born at Liége, September 22, 1856.

In 1878 he left the University of Liége with the honorary degrees of Ingénieur des Mines and Ingénieur des Arts et Manufactures, and completed his electrical studies at the Ecole Superieur de Télégraphie. He then became engineer in the Belgian State Telegraph Service, and in 1883 was called upon to take charge of an electro-technical institute which had been founded in connection with the Liége University. This institute is due to the princely gifts of M. Montefiore, a Senator, and is intended to educate electrical engineers. Since 1891 this Institute has possessed a building of which Prof. Ayrton said in his Presidential Address to the Institution of Electrical Engineers in 1892: "When I tell you that there are rooms for small direct-current dynamos, separate rooms for large direct-current dynamos, separate rooms for alternators, and that every three students have a separate little laboratory, with the necessary measuring instruments, all to themselves, your educational mouths will water, as mine did." Prof. Gerard is the author of "Eléments d'Électrotechnique," which has been translated into German; of "Leçons sur l'Electricité" (two editions of which have been issued in less than a year); and of several memoirs on the instruction and practical measurement of electricity. Prof. Gerard has had several flattering offers to manage industrial concerns, but he has preferred to continue in his educational career and to practise as a consulting engineer. He is a Chevalier of the Legion of Honour, of the Iron Crown, and several other orders.

GERHARDI, Charles A. Born 1837, and has been connected with telegraphy since 1854.

Mr. Gerhardi was engaged in the first Atlantic cable expeditions in 1857 and 1858; and has been manager of the Direct Spanish Telegraph Company since its formation in 1872. He has been a member of the Institution of Electrical Engineers since 1874, and represented the Direct Spanish Company at the International Telegraph Conferences of London in 1879, of Berlin in 1885, and of Paris in 1890.

GLADSTONE, John Hall, Ph.D., D.Sc., F.R.S. Born March 7, 1827, and educated at home.

In the year 1844 Mr. Gladstone began the study of science under Prof. Graham at University College, London. Afterwards he went to the University of Giessen to study chemistry under Baron Liebig, and in 1848 he took the degree of Ph.D. there. He lectured on chemistry at St. Thomas's Hospital from 1850 to 1853, at the same time conducting original researches. Most of these early investigations were on explosives and phosphorus compounds, and in recognition of their merit the author was in 1853 elected to the Fellowship of the Royal Society. Being then only 26, he enjoys the distinction of having been one of the youngest Fellows ever elected. While serving on a Royal Commission on Lighthouses in 1859, he had occasion to report on the magneto-electric light. In 1869 a Paper on "Refraction Equivalents of the Elements" appeared in the *Phil. Trans.*, forming a sequel to his research with the Rev. T. Pelham Dale on the "Refraction, Dispersion, and Sensitiveness of Liquids," which had been published in the *Phil. Trans.* for 1863. The permanence of the specific refractive energy of a body, notwithstanding any changes of temperature, aggregate condition, solution, or even chemical combination, having been established, the doctrine of refraction equivalents naturally followed. In 1861, 1872, and 1886 he read to the Chemical Society papers on essential oils. Dr. Gladstone was appointed Fullerian Professor of Chemistry at the Royal Institution in 1874, and filled the Chair until 1877. In 1874 he chose the "Voltaic Battery" as the subject of the Juvenile Lectures. In 1875 he delivered five lectures on chemical force, in the fifth of which he dealt with "The Copper-Zinc Couple and its Effects," pointing out the importance of the couple formed by the deposition of copper

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in arborescent crystals upon zinc, both from an electric and a chemical point of view. Dr. Gladstone, in conjunction with the late Mr. Tribe, performed many interesting experiments with it between 1872 and 1874, the experiments resulting in the discovery of several new substances. At the same time they described an "Air Battery," one in which the oxygen of the air takes part. In 1877 he gave a discourse to the Institution on the "Influence of Chemical Constitution on the Refraction of Light." In the spring of 1868, the number of chemical elements of which the refraction equivalent had been determined was 17, a number which in 1877 had been increased to 52. During 1878 and 1879 Dr. Gladstone's most important researches were concerned with the copper-zinc couple. The *Journal* of the Chemical Society for the former year contains a paper on "Analogies between the Action of the Copper-Zinc Couple and of Occluded and Nascent Hydrogen," and that for 1879 a continuation of the research. More recently its action on benzoyl compounds has been investigated. In 1880, again in conjunction with Mr. Tribe, he published a paper on "The Aluminium Iodine Reaction" in the *Proceedings* of the Royal Society. This process has given us a number of aluminium alcohols, and some curious products of their decomposition by heat. They subsequently published a Paper on "Thermal Electrolysis," and a small book on "The Chemistry of the Secondary Batteries of Planté and Faure." Dr. Gladstone has extended his consideration of refraction of light to another series of constants, namely, dispersion-equivalents, and, together with Dr. W. H. Perkin, has shown the connection between the phenomena of refraction, dispersion, and the magnetic rotation of light passing through liquid compounds. In conjunction with Mr. Walter Hibbert he has also made contributions to the British Association Committee on Electrolysis, and has sent various additional notes on Secondary Batteries to the *Phil. Mag.* In 1892 Dr. Gladstone and Mr. Hibbert communicated to the Institution of Electrical Engineers a Paper on "The Cause of the Changes of Electromotive Force in Secondary Batteries," in which they show the great influence of the strength of the sulphuric acid that is against the working surfaces of the plates. Dr. Gladstone was President of the Physical Society from its formation in 1874 to 1876, President of the Chemical Society from 1877 to 1879, and also President of the Education Society in 1880 and 1881. In his capacity as Member of the London School Board for the last twenty years he has done a good deal in promoting instruction in elementary physics and other branches of science.

GOOLDEN, Walter T., M.A., Fellow of the Physical Society. Born in 1848; educated at Magdalen College, Oxford; Science Scholar of Merton College, 1867; First Class in Natural Science, 1871.

Mr. Goolden is Examiner to the Civil Service Commission; Assistant Examiner in Natural Philosophy to the University of London from 1883 to 1887, and to the Science and Art Department, South Kensington, since 1871; and is a member of the firm of Messrs. W. T. Goolden and Co.

GORE, George, LL.D. (Edin.), F.R.S. Elected a Fellow of the Royal Society 1865. Was Lecturer on Physics and Chemistry during many years in King Edward's School, Birmingham.

Chiefly known as an electro-metallurgical chemist, and as an experimental investigator in chemistry, electro-chemistry, and voltaic electricity. He is the author of several books, viz., "The Art of Scientific Discovery"; "The Principles and Practice of Electro-Deposition"; "The Art of Electro-Metallurgy"; "Electro-Chemistry"; "The Scientific Basis of National Progress;" and "The Art of Electrolytic Separation of Metals" (this latter, and "Electro-Chemistry," belonging to *The Electrician* Series of Standard Scientific Works). We give the titles of his chief electrical investigations. Many of his experimental researches have been published in the *Proceedings and Transactions* of the Royal Society, and are well known. Amongst them are the following:—"Properties of Electro-Deposited Antimony" (1857, 1858, 1862); "Electro-Torsion" (twisting iron rods by means of electric currents, 1874); "Movements of Liquid Metals and Electrolytes in the Voltaic Circuit" (1860); "Production of Vibrations and Sounds by Electrolysis" (1861, 1862) "Development of Electric Currents by Magnetism and Heat" (1869); "Thermo-Electric Properties of Liquids and Metals" (1871); "Attractions of Magnets and Electric Conductors" (1874); "Rotations of Bar-Magnets and Conducting Wires on their Axes" (1875); "Thermo-Electric Properties of Liquids" (1878); "Chemico-Electric Relations of Metals in Solutions of Salts of Potassium" (1879); "Thermo-Electric Behaviour of Aqueous Solutions with Mercurial Electrodes" (1879); "Thermo-Electric Behaviour of Aqueous Solutions with Platinum Electrodes" (1881); "The Capillary Electroscope" (1880, 1881, 1882); "Effects of Electric Currents on Surfaces of Mutual Contact of Liquids" (1880); "Electric Currents caused by Liquid Diffusion and Osmose" (1881); "Influence of Voltaic Currents on Diffusion of Liquids" (1881, 1882); "Experiments on Electric Osmose" (1881); "Electrolytic Diffusion of Liquids" (1881); "Some Effects of Passing Electric Currents through Magnetised Electrolytes" (1881); "Relations of Heat to Voltaic and Thermo-Electric Action of Metals in Electrolytes" (1883, 1884); "Some Relations of Chemical Corrosion of Metals to Voltaic Currents" (1883); "Some New Phenomena of Electrolysis" (1884); "Unequal Electric-Conduction-Resistance at Cathodes" (1884); "On 'Transfer-Resistance' in Electrolytic and Voltaic Cells" (1885); "Relation of 'Transfer-Resistance' to Molecular Weight and Chemical Composition of Electrolytes" (1836); "Effects of Chlorine on the Electromotive Force of a Voltaic Couple" (1888); "Minimum Point of Change of Potential of a Voltaic Couple" (1888); "Change of Potential of a Voltaic Couple by Variation of Strengths of its Liquid"

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(1888); "Influence of Chemical Energy of Electrolytes upon the Change of Potential of a Voltaic Couple" (1888); "Effects of Different Positive Metals upon the Changes of Potential of Voltaic Couples" (1888).

In the *Proceedings* of the Birmingham Philosophical Society:—"On the Electrolysis of Sulphate of Copper" (1882); "The Electrolytic Balance of Chemical Corrosion" (1882); "Chemical Corrosion of Cathodes" (1882); "An Improved Thermo-Electric Pile for Measuring Small Electromotive Forces" (1883); "Electro-Deposition of Carbon" (1883); "Electrolysis of Fluoride, Chlorate, and Perchlorate of Silver" (1883); "On a Peculiar Class of Chemico-Electric Currents" (1884); "Influence of External Resistance on the Internal Resistance of Voltaic Cells" (1884); "Apparatus for Showing the Electro-Magnetic Rotation of Electrolytes" (1884); "On 'Resistance' at the Surfaces of Electrodes in Electrolytic Cells" (1885); "Evidence Respecting the Reality of 'Transfer-Resistance' in Electrolytic Cells" (1885); "A New Solution for the Electro Deposition of Metals" (1885); "Relations of 'Surface-Resistance' at Electrodes to Various Electric Phenomena" (1885); "Electrolysis of Alcoholic and Ethereal Solutions of Metallic Salts" (1887); "Relations of 'Transfer-Resistance' to the Molecular Weight and Chemical Composition of Electrolytes" (1887).

In the *Philosophical Magazine*:—"Production of Electric Currents by Unequally Treated Metals in Liquids" (1857); "Rotation of Metallic Tubes and Spheres by Electricity" (1858, 1859); "Apparatus for Examining the Electrical Relations of Mercury in Electrolytes" (1859); "Electrical Relations of Metals in Fused Substances" (1864); "Relation of Mechanical Strain to Magneto-Electric Induction" (1868); "Magnetism of Electro-Dynamic Spirals" (1870).

In the *Pharmaceutical Journal*:—"Electrical Relations of Iron and Copper in Electrolytes" (1853); "Ditto of Iron and Tin" (1856); "Ditto of Lead and Antimony" (1856); "Position of Aluminium in the Thermo-Electric Series" (1856); "Ditto of Sodium" (1856).

He has also made various chemical and physical researches, including: "Properties of Liquefied Carbonic Acid" (*Phil. Trans.* Roy. Soc., 1861); "On Hydro-Fluoric Acid" (*ibid.*, 1869); "Fluoride of Silver" (*ibid.*, 1870, 1871); "Liquefied Hydrochloric Acid Gas" (*Proc.* Roy. Soc., 1865); "Momentary Molecular Change in Iron at a Red Heat" (*ibid.*, 1869); "On Liquefied Cyanogen Gas" (*ibid.*, 1872); "Anhydrous Liquefied Ammonia Gas" (*ibid.*, 1872, 1873); Rotation of Hollow Spheres of Metal by Heat" (*Phil. Mag.*, 1859); "Molecular Movements and Magnetic Changes in Iron at Different Temperatures" (*ibid.*, 1870); and other researches.

Amongst the most recent of his published researches is one on "The Voltaic Balance" (see *The Electrician*, Vol. XXI., p. 337, and Vol. XXIII., p. 171), by means of which has been detected the voltaic energy of one part by weight of chlorine in 500,000 million parts of water (*Proc.* Roy. Soc., Vol. XLIV., p. 151); "A New Method and Department of Chemical Research" (*Phil. Mag.*, May, 1890); "A Method of Measuring Loss of Energy Due to Chemical Union of Electrolytes, &c.' (*Phil. Mag.*, Jan., 1892); and "A General Relation of Electromotive Force to Molecular Velocity" (*Proc.* Birm. Phil. Soc., 1892).

GRAVES, A., M.I.E.E. Born 1838. Connected with the Electric Telegraph Company at York, in various capacities, from 1852 until 1869.

Mr. Graves has been the telegraph superintendent of the North-Eastern Railway Company since January, 1870. He was the first to use, and to advocate the use of, copper wire for overhead telegraph lines.

GRAVES, James, M.I.E.E., F.I.Inst. Born at Chesterton, near Cambridge, August 4, 1833, and educated at Cambridge till 1844.

Mr. Graves studied with and assisted his father at Meppershall, Bedfordshire, until 1848, when the latter removed to Kent, having been appointed master of the school at Hoo, St. Werburgh, near Rochester. In 1850 Mr. Graves was appointed by the Rev. Thomas Dale as assistant master at St. Pancras National School, Euston-square, London. On 26th December, 1852, he entered the service of the Electric Telegraph Company, Founders'-court, Lothbury, and was transferred in February, 1853, to the Southampton Station. In 1857 he was, at Mr. C. F. Varley's request, removed from Southampton to the Foreign Gallery at Lothbury, London, whence he was, in 1858, transferred to the Jersey Station of the Channel Islands Telegraph Company. He remained in charge of that station, until, at Mr. C. F. Varley's request, he undertook, in 1861, the duties of submarine electrician to the Electric and International Telegraph Company's steamer "Monarch." During 1862 and 1863 he acted as Mr. Varley's travelling assistant, fixed the Newcastle time-gun apparatus, visited South Wales and Ireland, introducing to the district superintendents Mr. Varley's universal galvanometer, and the system of daily tests of the land wires in those districts. When the Atlantic telegraph scheme was revived in 1864 he was lent to the Atlantic Telegraph Company to test the cable during its manufacture and shipment, as Mr. Varley's representative, that gentleman having been appointed as the chief electrician to the Atlantic Company. Upon the sailing of the 1865 Expedition, Mr. Graves was appointed their superintendent at Valentia by the Atlantic Telegraph Company, which appointment was renewed when the 1866 Expedition proved successful, and the working of the cables was taken up by the Anglo-American Telegraph Company. From June to October, 1870, Mr. Graves acted as electrician to the Anglo-American Telegraph Company's steamer "Robert Lowe" during the repairs of the 1866 cable off Newfoundland, and of the French Atlantic cable off Cape Sable, Nova Scotia; and in June and July, 1874, he acted in a similar capacity on board

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the s.s. "Minia" during the repair of the 1866 cable off Valentia. In 1879, in conjunction with Mr. J. B. Stearns, he succeeded in establishing duplex working upon the 1874 Anglo-American cable, and has since applied Mr. Stearns' system of duplex working to the 1873 and 1880 cables belonging to that company. In 1882, when the German Union Telegraph Company laid their cable from Valentia to Emden, North Germany, Mr. Graves was appointed to the superintendentship of the German Union Company, jointly with that of the Anglo-American Company. On January 1, 1889, the German Government took over the working of the Emden cable, retaining Mr. Graves in the same position as he held under the German Union Company, which appointment he still holds. Mr. Graves has contributed several Papers to the Institution of Electrical Engineers, amongst which those on "Earth Currents," on "Vibrations due to Earth Plates," and on "Curbed Signals for Long Cables," attracted much attention. He has been a member of the Institution since its formation in 1872. He was elected a member of the Society of Arts in 1874, is a Membre Fondateur of the Société Internationale des Electriciens, and a Fellow of the Imperial Institute.

GRAY, Prof. Andrew, was born at Lochgelly, Fifeshire, in 1847; and received his early education in that place. Thence he proceeded to Edinburgh, and attended classes at the Watt Institution and School of Arts (now the Heriott Watt College), gaining the Bryson prize for Mathematics and an exhibition of £25 presented to the Institution by Sir Joseph Whitworth.

Mr. Gray afterwards entered at the University of Glasgow, and graduated Master of Arts, gaining at the same time the Eglinton Fellowship for proficiency in Mathematics and Natural Philosophy. In the second year of his course there he was nominated by Sir William Thomson (Lord Kelvin) to an experimental scholarship in Electricity and Magnetism given by Mr. Heugh, of Tunbridge Wells, to the Andersonian University, Glasgow. This he held for two sessions, when he was asked by Sir William Thomson to become his private secretary and experimental assistant. While serving in this capacity Mr. Gray had, for a short time, as a fellow student Prof. John Perry, and assisted with his brother (Mr. T. Gray) in the carrying out of the greater part of Sir William Thomson's researches on the "Effects of Stress on Magnetisation." This post Mr. Gray held until 1880, when he had the honour of being invited by Sir William Thomson, as Professor of Natural Philosophy in the University of Glasgow, to accept the higher post of his official assistant. In 1884, on the foundation of the University College of North Wales at Bangor, Mr. Gray was appointed Professor of Physics in that institution, and that post he still holds. In 1892 Mr. Gray contributed a series of articles to *Nature* on "Electrical Measurement," which were reprinted, with additions, in a small book entitled "Absolute Measurements in Electricity and Magnetism," which was published by Macmillan and Co. in 1884. This work was rapidly sold out, and a new edition was called for at the beginning of 1885, when also it was reprinted in French in *La Lumière Électrique*. It was, however, decided to extend the scope of the work so as to include a fairly complete account of the determinations of electrical and magnetic constants made since the Absolute System of Units was founded. This task proved a very laborious one, and occupied the author until the end of 1892, when the work was completed by the issue of Vol. II. in two parts containing "Magnetism" and "Electromagnetism." The delay caused by the vast amount of Papers to be read and digested, however, enabled the author to include in the second volume accounts of recent magnetic research, and Hertz's experimental verification of Maxwell's "Electromagnetic Theory of Light." In 1889, at the request of the publishers, who had been advised that the original book had proved useful to students of practical electricity, it was decided to recast that work and issue a second edition, without seriously adding to the number of topics discussed in it. The book was, however, in great part rewritten, and augmented in the process to twice its original size, and was published in 1889. Besides these works Prof. Gray is the author of several Papers on electric and magnetic subjects, some of them in conjunction with his brother, Prof. Thomas Gray, now of Terre Haute, U.S.A. He is at present engaged on a systematic treatise on magnetism and electricity, in which an attempt will be made to present the whole subject from the point of view of action in the electromagnetic field. Prof. Gray is a Fellow of the Royal Society of Edinburgh, and a Member of the Physical Society. He is also, at present Examiner in Mathematics and Natural Philosophy for Degrees in Arts in the University of Glasgow, and in Physics for Degrees in Medicine in the same University.

GRAY, Elisha. Born at Barnsville, Ohio, U.S.A., August 2, 1835.

When a lad Prof. Gray was apprenticed first to a blacksmith, and subsequently to a carpenter and boat-builder. Upon the completion of his several apprenticeships he entered Oberlin College, and made a special study of physical science, supporting himself meanwhile by working at his trade. In 1867 Prof. Gray obtained his first patent for telegraphic apparatus—a self-adjusting relay. Since that time he has taken out nearly 50 patents, the most important relating to his printing-telegraph system, which was largely in use before the advent of the telephone, the harmonic telegraph, the telephone, and the telautograph. All of Prof. Gray's inventions bear the stamp of thorough originality, and in no sense can he be called an adapter of ideas furnished by others. He was the first to transmit several messages simultaneously over a wire on the harmonic plan, and his famous caveat of February 14, 1876, contains the first written description of the speaking telephone. The first speech transmitted over a wire was with instruments similar to those described in

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that caveat. Prof. Gray has been occupying himself for some years past with his telautograph, or writing telegraph, and in this wonderful invention he again displays remarkable genius and individuality. His laboratory is at Highland Park, Ill., where he resides. He is a member of the faculty of Oberlin College, and in 1878 was honoured at the Paris Exhibition with the red ribbon of the Legion of Honour.

GREENER, John Henry, M.I.E.E., C.E. Born at Etherly, county Durham.

In 1843 Mr. Greener began his career in London on the Blackwall Railway, and was there first connected with the electric telegraph. In 1847 he entered the service of the old Electric Telegraph Company. In 1849 Mr. Greener returned to the Blackwall Railway in charge of the telegraphs, and in 1853 rejoined the Electric Telegraph Company, Mr. Edwin Clark being then engineer. The same year he was appointed by the company to proceed to Norway to construct the telegraph on the Norwegian Trunk Railway, which was at this time being made. This was the first line of telegraph erected in Norway. In 1855 he went to Denmark to construct the telegraph on the Royal Danish Railways. Shortly after his return from Denmark, Mr. Greener was appointed by the Telegraph Company to proceed to Ireland, to report on the state of the telegraph lines between Dublin and Galway, for the purpose of establishing direct communication with the Atlantic cable. He was afterwards appointed by the Telegraph Company as outdoor assistant to Mr. Latimer Clark (then engineer to the company), which position Mr. Greener held until the end of 1860. At this time he was selected by the Secretary of State for India as telegraph engineer to accompany Colonel, now General Sir Arnold B. Kemball, K.C.B., at that time British Resident at Baghdad, to examine and report upon the condition of the Turkish telegraph lines from Constantinople, through Asia Minor and Turkish Arabia, down to the Persian Gulf, with the view of establishing overland telegraph communication to India, after the failure of the Red Sea cable. In 1862 Mr. Greener returned to England, and reported personally to the India Office as to the condition of the above lines, and the possibility of their extension through Mesopotamia to the head of the Persian Gulf. In the same year he proceeded to Bombay, to accompany, as telegraph engineer, the expedition for taking soundings and selecting suitable stations as landing places for the proposed cable from Karachi to Fao. Mr. Greener constructed the land lines from Baghdad through Mesopotamia down to Fao, at the head of the Persian Gulf. The cable was laid successfully to Karachi, and communication between England and India completed in January, 1864. In 1865 Mr. Greener returned to England. Since that period he has been connected with the India Office as Inspecting Engineer for Telegraph Stores. Mr. Greener is also Inspecting Engineer for Telegraph Stores for the Crown Agents for the Colonies, and for the Agent-General for the Cape of Good Hope.

GREENHILL, John Hayton. Born in Belfast, 8th May, 1846; educated at the Collegiate School, and afterwards at the Royal Academical Institution. Obtained the degree of Bachelor of Music at Trinity College, Dublin, in 1869.

An ardent student in various branches of science, especially electricity, he became commercially interested in electric lighting in 1881 by his connection with Messrs. Crompton & Co., for whom he acted as Irish agent for many years. He commenced the manufacture of dynamos early in 1883, and has constructed a great many machines of various sizes, a modified type of Messrs. Mather and Platt's "Manchester" dynamo (for the construction of which he holds a licence from that firm) receiving his especial attention. He was elected President of the Belfast Natural History and Philosophical Society (one of the oldest scientific societies) in 1889, and re-elected for the sessions 1890-1891. He is a Member of the Institution of Electrical Engineers.

GÜLCHER, R. J. Born June 8, 1850, at Biala, near Bielitz, in Austrian Silesia; educated partly at the Protestant School of his native town and at the "Real-Gymnasium" (a Latin school), at Görlitz, after which he attended the Polytechnic School at Zürich, and the Polytechnic Institute "Joanneum" at Graz. He showed remarkable aptitude for technical engineering and mathematics at an early age.

In 1872 Mr. Gülcher undertook the management of a small mechanical repairing workshop in his father's cloth manufactory, and such was his energy that in 1875 he found himself in possession of a large ironfoundry and machine-factory. In 1878 he bought of Messrs. Siemens and Halske three electric arc lamps, together with as many dynamos, for the lighting of his foundry; each dynamo supplying the current for one lamp only, as at that time the "division of the electric light" as to arc lamps was unknown. After some few days, however, the von Hefner-Alteneck regulators refused to act, owing to the dust in the foundry works, and it was this circumstance that led him to the invention of a new and improved arc lamp, without clockwork. Experimenting upon these new lamps, he found that two and more of them would work satisfactorily, when connected in multiple or parallel arc, from *one* dynamo. This astonishing result, hitherto deemed impossible, led Mr. Gülcher to the invention of his improved dynamo, and, finally, to that of his system of dividing the electric light, based on the parallel arc, and known as "the Gülcher low-tension system," which enabled him to run any number of arc and incandescent lamps of various candle-power from one single dynamo. In 1881 Mr. Gülcher exhibited his new system at the Paris Exhibition, where he was awarded a gold metal, and, since then, the Gülcher system has been acknowledged more and more as the only one by which an actual and perfect division of the electric light is attained. In 1882 his patents for Great Britain were acquired by the Gülcher Electric Light and Power Com-

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pany, and a year later the company "Helios," at Ehrenfeld-Cologne, purchased his German patents. His Austrian and other patents are executed by his own factory in Biala. Since 1885 Mr. Gülcher, in connection with the firm of Julius Pintsch, in Berlin, has been studying and experimenting upon the principle of the "Direct Transmutation of Heat into Electricity." As the first result of these studies, in 1887, he obtained patents for the invention of a new and improved thermo-electric battery of a remarkable efficiency and durability, and lately has made further improvements in that direction.

HASKINS, Caryl Davis. Born at Waltham, Mass., 1867, and educated in public schools in the United States and at Allison Towers and Rosindale Schools, England, London University, &c.

Mr. Haskins's early study was directed chiefly towards the "Natural Sciences," more especially Zoology and Biology. He took first and second-class honours at South Kensington in various scientific subjects. In 1885 he joined Prof. Henry Ward, of Rochester, N.Y., as assistant in Zoology; but, returning to England, he took up the study of engineering, entering the service of his father's firm, Haskins, Davis and Co., of London. In 1887, having already taken up the study of electrical engineering, Mr. Haskins entered the employ of Messrs. S. Z. de Ferranti and Co., of London, as an assistant to Mr. Ferranti. While there he became more especially identified with early work on transformers and recording meters, finally taking charge of the manufacture of the Ferranti meter at the Charterhouse-square works. During his connection with Mr. Ferranti, Mr. Haskins was so fortunate as to assist at many of the early 10,000-volt experiments. Returning to America in 1888, Mr. Haskins first engaged in business in New York, and in 1889 he entered the service of the Thomson Electric Welding Company, of Lynn, Massachusetts, as constructing draughtsman and electrician. His experience with recording meters, however, led within a brief time to his forming a connection with the Thomson-Houston Electric Company, also of Lynn, with whom he undertook testing and certain experimental work in connection with the Thomson Recording Wattmeter, then just developed. The subject growing in importance, Mr. Haskins, in 1890, took charge of the Company's meter business, which in 1891 had grown to such considerable proportions that it was created a department, and he became the manager. On the consolidation of the Thomson-Houston and Edison Companies, under the general title of the General Electric Company, Mr. Haskins took the management of the united meter interests of the two concerns, to which, early in 1893, all the indicator and instrument business was added. Mr. Haskins is the inventor and patentee of several useful electrical devices. He is a member of the American Institute of Electrical Engineers, the New York Electrical Society, &c. Mr. Haskins has read numerous Papers before scientific societies, and has also lectured on electrical subjects. In 1892 his first book was published, entitled "Transformers"; and he is the co-author of "Questions and Answers about Electricity." He has also written numerous Papers which have appeared in various technical and other journals from time to time.

HAYNES, Frederick Troake Jago, M.I.E.E. of England and of America, Divisional Engineering Superintendent of Telegraphs, Great Western Railway, Taunton. Born at Exeter on 9th April, 1844; was educated at Hele's School in that city.

Mr. Haynes entered the service of the Bristol and Exeter Railway Company in the telegraph superintendent's office at an early age. In 1865 the Bristol and Exeter Railway Company decided to adopt the block telegraph system. Mr. Haynes was from then, until the end of 1869, engaged in inspecting and reporting upon all matters affecting the safe working of the line. In January, 1870, Mr. Haynes succeeded the telegraph superintendent. Mr. Haynes has devoted much time and attention to the economical and efficient maintenance of land lines, and has written some interesting papers on that subject. He has also effected improvements in various railway electrical appliances. On June 1, 1888, the telegraphs on the Great Western Railway, from Swindon throughout the West of England and South Wales, were placed under his supervision.

HEDGES, Killingworth, M.I.C.E., M.I.E.E. Born at Streatham, Surrey.

Mr. Hedges was educated at Brighton until the age of sixteen, when he was articled to Mr. James Easton, C.E., for five years, during which period he served his time in the shops of the firm of Easton and Amos. He afterwards superintended the erection of the large pumping machinery on the North Holland Sea Canal, and took a post as engineer on the construction of the Denver and Rio Grande Railway, Colorado, obtaining two Miller prizes at the Institute of Civil Engineers for Papers describing these works. His first connection with electricity was in 1873, when he was sent to Paris to report on the then recently-invented Jablochkoff candle. In 1879, he was employed to report to the Mersey Dockyard as to the suitability of the electric light for the Liverpool docks, and afterwards carried out the present installation. He superintended the electric lighting of the ss. "Chimborazo," in 1880, with the André lamp, the first steamer in which the incandescent light was adopted. He exhibited switches and arc lamps at the Paris Electrical Exhibition, and obtained a bronze medal; also at the Crystal Palace, where a silver medal was awarded him. He invented the fusible cut-out of metallic foil, which was perfected and used throughout the Vienna Electrical Exhibition, and for which a special certificate from the Scientific Commission was granted. He published a pamphlet entitled "Useful Information on Practical Electrical Lighting," in 1879; and a book with the same title in 1881. He is the author of "The Supply of Electricity by Local Authorities," also "Pre-

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cautions on Introducing the Electric Light;" of a Paper entitled the "Fire Risks of Electric Lighting," read before the Royal Institute of British Architects in 1884; and was awarded a Telford Premium by the Institution of Civil Engineers for his Paper on "Central Station Lighting," published in Vol. LXXXVIII. of the *Minutes*, 1887. This was published in book-form, revised up to date, January, 1887. He has also written several miscellaneous Papers on scientific subjects. Mr. Hedges has devoted his attention more especially to the improvement of electrical fittings and to the manufacture of carbons. He is also author of a Paper entitled "Precautions on Taking Supply of Electricity by Means of Transformers," read at Newcastle Meeting, British Association, 1889, in which the necessity was shown of protecting the secondary circuit by means of some safety device to earth the circuit in event of the insulation of the transformer giving way. In 1891, after visiting the Electrical Exhibition at Frankfort, he obtained permission from the various German municipalities and firms, who there described the systems of lighting the principal towns, to reproduce their reports and plans in a book, entitled "Continental Electric Light Central Stations." He has recently given his attention to the question of doing away with oil in bearings, and has invented a special form of carbon material, termed "carboid," which can be used for the axle bearings of tramcars and for shafting, allowing of the bearing to be heated to a considerable temperature without materially increasing the friction, which has been successfully adopted. The invention was shown at the *conversazione* of the Royal Society in 1891, and a descriptive Paper on "Materials for Bearings used without Lubricants" was read at the Edinburgh meeting of the British Association.

HEFNER-ALTENECK, Friedrich von.

Born in the year 1845, at Aschaffenburg, in the kingdom of Bavaria; is the son of Dr. J. H. von Hefner-Alteneck, the archæologist. In the year 1851 Herr von Hefner-Alteneck went with his parents to Munich, and even in his early youth he displayed a decided inclination for the study of natural science and great skill in the production of mechanical appliances with the simplest means. Later on he attended the Polytechnic Schools at Munich and Zurich, and for about twelve months he devoted himself to practical work in mechanical optical establishments in Munich. A visit to the Paris Exhibition of 1867 gave him an opportunity, which he eagerly seized, to become directly acquainted with mechanical science before he entered into practical life. On the return journey, in Berlin, Herr von Hefner-Alteneck inquired of the late Dr. Werner Siemens whether the latter could hold out any prospect of his obtaining an appointment in the firm of Siemens and Halske. The reply was to this effect: "If you like to commence at the bottom as a workman in the shop you can enter at once." To this von Hefner-Alteneck consented. He did not long remain a simple workman, but was soon transferred from the workshop to the engineering department, of which he became director when a vacancy occurred. In this capacity Herr von Hefner-Alteneck originated many of the inventions which have emanated from the firm of Siemens and Halske, several of which are patented in his own name and in that of Siemens and Halske. Amongst these may be named various important improvements in telegraphic apparatus, including an apparatus with an ingenious feed motion for the continuous delivery of Morse characters, by means of a key-board, on which the separate letters are taken, irrespective of the different length of the same, as in a modern type-writer; the simplification of so-called electric alarms, and safety appliances for railways, &c. The best known inventions of Herr von Hefner-Alteneck refer to electric lighting, and he stands in the foremost rank among its originators, as far as the new era is concerned. When he commenced the study of electric lighting, in 1870, there already existed the Pacinotti-Gramme ring armature. In the year 1872 he invented the drum armature for the dynamo-electric machine, by which the disadvantages presented by the interior coils of the Gramme ring were avoided, and by employing a massive iron cylinder, instead of the ring, the number of the magnetic lines was increased. In 1877 he invented his well-known machine for alternating currents. Both machines, but especially the former, have served as types for a whole series of dynamos which comprises the Edison machine. In the year 1876 Herr von Hefner-Alteneck constructed first a so-called bar armature for his drum armature for low electric tension with a peculiar kind of conducting arrangement on the front faces, in two different planes, which solved the problem of the reciprocal crossing of many coils in the narrowest possible space. Although the Jablochkoff candles met with great success in 1877 when employed for street-lighting in Paris, Herr von Hefner-Alteneck was of opinion that this success could not last, notwithstanding the seductive simplicity of the candles, and that the future of electric lighting depended on the improvement of the old carbon light regulators. In this spirit he constructed his differential lamp, several of which could be worked in one circuit, with the mechanism applied above the lantern, which has since become typical for all arc lights. With this lamp, and the machine for alternating currents already referred to, the firm of Siemens and Halske established its first electric lighting installation with a divided-regulator light in the Kaiser Gallery in Berlin, 1879, and similar ones shortly after in the Berlin and Munich railway stations, which remain unchanged at the present time. The invention produced at the same time by the Gebrüder Siemens in Charlottenburg of the so-called wick carbons, which rendered the light of the arc lamp steadier than formerly, contributed considerably to the success of this system of lighting, and it increased so rapidly that at the Paris Electric Exhibition in 1881 the Jablochkoff electric candle was eclipsed by the numerous installations with the divided light, and by Edison's incandescent lamp

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PROF. VON HELMHOLTZ.

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also, which appeared among them. Herr von Hefner-Alteneck's more recent work has referred especially to the improvement of the various kinds of apparatus required for electric lighting in all its forms, to the improvement of measuring instruments of all kinds for practical use in the machine stations, &c. A dynamometer, invented by Herr von Hefner-Alteneck, which measures the force transmitted by a belt direct, is also widely known. Finally, it should be mentioned that Herr von Hefner-Alteneck proposed a new unit of light in 1883, consisting of a small and very simple lamp with a burner of an invariable size, in which a substance, having a perfectly definite chemical composition—"amyl-acetate"—is burned with an unvarying height of flame. This unit of light has given rise to many researches and treatises in Germany, where, in fact, it is now almost exclusively employed under the name of the Hefner Lamp, as a standard in measuring the intensity of light. Herr von Hefner-Alteneck, who retired from the firm of Siemens and Halske at the end of 1889, is occupying himself since his retirement chiefly in scientific research. His writings are to be partly found in the lectures and treatises which are printed in the *Electrotechnische Zeitschrift* and other papers, and also in the respective patents, &c.

HELMHOLTZ, His Excellency Hermann Ludwig Ferdinand von. Born August 31, 1821, at Potsdam.

In his seventeenth year Helmholtz entered the University of Berlin as a student, and wished to devote himself to the study of physics; but circumstances compelled him to enter on the study of medicine. In 1847, in a small pamphlet on "The Conservation of Energy," he showed that no energy is lost in the world, but that it alters only in its mode of manifestation. At the same time, he showed that all the processes of Nature obey the laws of mechanics. Previously to this, heat had always been regarded as a "substance." Helmholtz showed "that the phenomena of heat can all be looked upon as motion." His article was, however, rejected by *Poggendorff's Annalen*, and amongst the members of the Berlin Academy only Jacobi, the mathematician, espoused his cause. Even when his fame penetrated through wide circles, doubt was thrown on the originality of this epoch-making work. Helmholtz had written his pamphlet in ignorance of the work of Robert Mayer (1842 and 1845). In 1850 Helmholtz estimated the mean rate of transmission of nervous activity in the motor nerves of the frog, and found it to be 26·4 metres per second, or less than 10 times slower than the velocity of sound in air. In the course of these researches, he enriched physiological experimental methods by his myographion. In the year 1851 Helmholtz astounded the scientific world by his discovery and description of the ophthalmoscope, for examining the retina in the living eye. When Professor of Anatomy and Physiology in Bonn (1855), he investigated the mixture and visual action of the spectral colours. Ten laborious years he devoted chiefly to his "Text Book of Physiological Optics" (1856-1866). In this work he made it "his duty to test and verify all essential points by his own observations and experiments." The new Chair of Physiology in the University of Heidelberg was offered to Helmholtz, and accepted by him. It was in Heidelberg that he displayed a new aspect of his genius. He there produced his work entitled "The Doctrine of Tone Sensations as a Physiological Basis of the Theory of Music." In 1871 Helmholtz accepted the Chair of Physics in the University of Berlin. From this time forward he was engaged chiefly in inquiries in the great departments of electricity and hydrodynamics. In the autumn of 1887 the German Empire founded a physical-technical institution, Dr. Werner Siemens having given for the purpose a sum of £25,000. The institute comprises two departments, one for purely scientific purposes, and the other concerned with the application of scientific physics to technical purposes. The first is a laboratory for the advancement of pure science. Such work as may be necessary for the advancement either of science or of technical pursuits, and which requires for its accomplishment specially fitted rooms, costly apparatus, and unlimited time on the part of the worker, is to be done there. The second department has for its object the development of technical-scientific methods and appliances, and the keeping of industry abreast of the progress of science. Over this great and important new institution, Helmholtz was chosen by the Government to preside, whilst he was further appointed director of the first, or purely scientific, department. In consequence, he resigned the Chair of Physics and the directorship of the Physical Institute of Berlin, though he still retains the position of Professor ordinarius in the University, and delivers lectures on special subjects of theoretical physics. In 1883 the German Emperor conferred on Herr Helmholtz and on his family the honour of hereditary nobility. In 1892 Prof. Helmholtz attended the meeting of the British Association in Edinburgh, and lent the support of his valuable name to a scheme for the internationalisation of the fundamental electrical units. He visited Chicago during the recent International Electrical Congress.

HERING, Carl, B.Sc., M.E., was born 1860 in Philadelphia, U.S.A., and is the son of Dr. Constantine Hering, of Philadelphia, the well-known founder of homœopathy in America. He received his collegiate education in the University of Pennsylvania at Philadelphia, taking the course in Mechanical Engineering. He graduated in 1880, taking the degrees of Bachelor of Sciences and Mechanical Engineer.

In 1881 Mr. Hering was elected Instructor in Mathematics and Assistant in Mechanical Engineering in the University of Pennsylvania, which position he relinquished to become Assistant in Physics in the same University under Prof. Barker, at that time one of the principal consulting electricians of the Edison Company. In 1883 Mr. Hering was elected Commissioner of the Franklin Institute of Pennsylvania to the

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International Electrical Exhibition at Vienna, at which exhibition he was made an active member of the International Jury who undertook the scientific tests of the exhibits. He then continued his studies at the Polytechnikum in Darmstadt, Germany, under Prof. Kittler, which was at that time one of the very few colleges where electrical engineering was taught as a special course, and shortly after beginning his studies Prof. Kittler appointed him his assistant. In 1884 he became acting-electrician for the Philadelphia International Electrical Exhibition and Member of the Scientific Commission appointed to make the tests and reports. In the latter capacity he urged the importance of a comparative life-test of incandescent lamps, which, though at first opposed and ridiculed by many members of the Commission, was finally started and was afterwards carried out by Prof. Marks for the Franklin Institute. These tests, now well known as the Franklin Institute tests, remain the only ones of the kind made at an exhibition. In 1885 he was electrical engineer first for one of the large manufacturers in Germany and then for a company in Philadelphia, after which he commenced his present occupation as consulting electrical engineer in the latter city. In 1889 Mr. Hering was sent to Paris by the United States Government to report on the electrical exhibits at the Paris International Exposition, which Report has just been published. While there he was appointed a member of the Jury in Class 62 (Electricity), representing the United States. He was also elected delegate from the Franklin Institute to this exhibition for the class "Electricity," and was representative of the American Institute of Electrical Engineers at the International Electrical Congress in Paris. At the close of the Exhibition he received the decoration known as the "Gold Palms" from the French Government. In 1891 he was Chairman of the Delegation of the American Institute of Electrical Engineers to the International Congress of Electricians at the Frankfort Electrical Exhibition; at this Exhibition he was also a member of the Scientific Commission (Jury), and a delegate from the Franklin Institute. For about a year he was one of the editors of the *Electrical World*. Mr. Hering is the author of several Papers on electrical subjects and of several books on electrical subjects. He is the inventor of several improvements in dynamos and storage batteries.

HERTZ, Dr. Heinrich, was born in 1857, at Hamburg, and is the son of Senator Dr. Hertz. He studied engineering till 1878, and then devoted himself to physics under Helmholtz and Kirchhoff, at Berlin, where he took the degree of Doctor of Philosophy in 1880. He was assistant to Helmholtz till 1883, when he became "privat docent" in the University of Kiel. In 1885 he was made Professor of Physics in the Technical College at Karlsruhe, and in 1889 succeeded the late Dr. Clausius in the Chair of Physics at Bonn. In 1889 he was elected an honorary member of the Manchester Philosophical Society, and is also a corresponding member of the Royal Academy at Berlin. Most of his experimental work deals with electricity. Towards the end of 1886 he detected a special action of ultra-violet light upon the electric discharge. In the following year he obtained evidence that electric induction was propagated through air with a finite velocity. In the course of 1888 he succeeded in producing electrical waves and rays in air, which had been predicted long ago by Maxwell, and which was studied theoretically by Fitzgerald, Heaviside, Lodge, and others. Dr. Hertz's researches were translated by Mr. G. W. de Tunzelmann, and published in *The Electrician*; and Messrs. Macmillan and Co. have recently published a translation by Mr. D. E. Jones.

HOHO, Paul. Born at Wittem (Holland), September 29, 1863.

Having completed his professional studies in Holland, M. Paul Hoho in 1881 began an engineering course at Louvain University, where he obtained in 1885 and 1886 respectively the diplomas of Civil and Mechanical Engineering and of Mining and Industrial Engineering. A few days after leaving Louvain M. Hoho became engineer to the Société Industrielle d'Electricité at Brussels. In 1887 he joined the Société l'Electrique, where he soon became chief engineer. In 1889, he changed this position for that of consulting engineer to the Société, which he still occupies. While at the University he invented a system of transmitting drawings, &c., by telegraph, to which, however, he himself did not attach much importance. In 1889 he brought out his "Composite Field" dynamo, which is able to yield two different currents at one and the same time from a single armature. M. Hoho successfully designed and constructed, at his own risk, a 21-kilowatt machine of this type, without any preliminary experimenting. He has also brought out a dynamo with "composite magnetic excitation," in which the speed may be varied through wide limits without altering the volts. M. Hoho was one of the earliest of practical pioneers and designers of continuous-current transformers. In 1890 M. Hoho and Prof. Lagrange, of the École Militaire (Brussels), discovered a peculiar luminous and calorific phenomenon, which occurs under certain circumstances in liquids when traversed by an electric current. Minute investigation leads the discoverers to anticipate a possible practical utilisation of the phenomenon. A Paper laid before the Académie Royale des Sciences in August, 1891, describes the first portion of their researches and their explication of the phenomenon. M. Hoho is a member of the Société Internationale d'Electricité, of the Institution of Electrical Engineers (London), and is on the Council of the Société Belge d'Electriciens.

HOLMES, Arthur Bromley. Born at Derby, June 8, 1849; educated at Repton School, near Burton-on-Trent.

Mr. Holmes, after leaving school in 1868, served a pupilage of five years under Mr. A. Buchanan, M.Inst.C.E., at the Britannia Ironworks, Derby, and was subsequently for seven years in the employment of Messrs. Handyside

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JOHN HOPKINSON.

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and Co. at that address, engaged in superintending the construction and erection of the various large engineering works undertaken by that firm. In 1881 Mr. Holmes commenced business on his own account in Liverpool as a consulting engineer in partnership with Mr. J. C. Vaudrey. He devoted his attention specially to electric lighting, and has been managing engineer of the Liverpool Electric Supply Company (Limited) since its formation in the year 1883. The central supply station of the Liverpool Company was one of the earliest established in this country, and has been in successful operation ever since. The company also carried out the entire electric lighting, including the provision of steam power, of the Liverpool International Exhibitions of 1886 and 1887. Mr. Holmes was elected a member of the Institution of Civil Engineers in 1888, and is a member of the Institution of Electrical Engineers. He is consulting engineer to the Birmingham Electric Supply Company. Mr. Holmes is the author of two useful books on electric lighting—viz., "The Electric Light Popularly Explained," and "Practical Electric Lighting," both of which have had a large sale, and reached the fifth edition.

HOPKINSON, Edward, M.A., D.Sc., M.Inst.C.E. Born in May, 1859; son of Alderman Hopkinson, M.Inst.C.E., of Manchester. He was educated at Owens College, Manchester, and obtained an exhibition in mathematics at Emmanuel College, Cambridge, in 1877, and subsequently a Foundation Scholarship. He graduated as 10th Wrangler in the Mathematical Tripos of 1881, and was elected to a Fellowship at Emmanuel College in 1883. In 1831 he took the degree of D.Sc. in the University of London in the branch of electricity and magnetism treated mathematically.

In 1882 Dr. Hopkinson became assistant to the late Sir William Siemens, and continued with him until his death. During this time he carried out the experiments at Portrush in connection with the first electrical tramway in the United Kingdom. He received a silver medal from the Society of Arts for a Paper on the Portrush Tramway, read before the Society. After the death of Sir William Siemens Dr. Hopkinson designed and carried out, in 1885, the Bessbrook and Newry Electrical Tramway, which is worked entirely by water power, and still continues to be the only electrical tramway on which both goods and passengers are carried on a large scale. He read a Paper before the Institution of Civil Engineers on the construction and working of this tramway, which was awarded a gold medal and Telford premium. In 1887 he became a partner in the firm of Messrs. Mather and Platt, of Salford, and undertook the charge of the Electrical Engineering Department, of which he continues head. When the firm was transformed into Mather and Platt, Limited, he became one of the managing directors. He is the inventor, in conjunction with Dr. John Hopkinson, of the "Manchester" dynamo, and of various improvements in connection with dynamo machines and the applications of electricity. He is the joint author with Dr. John Hopkinson of a Paper on Dynamo Electric Machinery, printed in the *Transactions* of the Royal Society. He designed the electrical plant for the City and South London Electric Railway, and the electrical part of the work was carried out under his direction. This undertaking was described by him in a Paper read before the Institution of Civil Engineers in 1893, for which he again received a Telford premium and Stephenson medal. Dr. Hopkinson is a member of the Institution of Electrical Engineers.

HOPKINSON, John, D.Sc., F.R.S. Born at Manchester in the year 1849.

Dr. Hopkinson is the eldest son of Mr. Alderman Hopkinson, of Manchester. His mother is a daughter of the late John Dewhurst, of Skipton. Till the age of fifteen and a-half he was educated at Lindow Grove School and Queenwood College, both schools having for their principal Mr. Charles Willmore. He then went to Owens College, remaining there two years and a-half. From Owens College he went to Trinity College, Cambridge. At the beginning of 1871 he graduated as Senior Wrangler, and afterwards obtained the first Smith's prize. Whilst an undergraduate at Cambridge, he graduated as Doctor of Science at London University. Early in 1872 he joined Messrs. Chance Brothers and Company's Lighthouse Works, near Birmingham, as engineer, and resided in Birmingham nearly six years. Into lighthouse work he has introduced many improvements, notably the Group Flashing Apparatus; probably Dr. Hopkinson has designed a greater number of special forms of lighthouse apparatus than anyone else, and with uniform success. His connection with the firm still continues. In 1878 he moved to London and began general practice as an engineer. He speedily became known as an expert in patent cases; an important part of his practice still lies in this line. A good deal of Dr. Hopkinson's leisure time has been devoted to scientific research. He has published several important Papers on "The Specific Inductive Capacity of Bodies;" but is perhaps best known for his researches on dynamo machines and subjects allied thereto. His attention was first directed to this subject in 1879, when he made a series of experiments on a Siemens machine, and first introduced the methods of the characteristic curve. Early in 1883 he made improvements on the Edison dynamo machine, which may be said to be the parent of the great improvement which the last six years has seen in dynamo machines of all sorts. In 1883 also he was appointed to lecture at the Institution of Civil Engineers. On this occasion he developed certain points in the theory of alternate currents which were subsequently carried further in a Paper read before the Society of Telegraph Engineers. During the next three years he worked out the theory of the dynamo machine on a thoroughly satisfactory basis, made elaborate experiments on the magnetic

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properties of iron and steel, and then, in conjunction with his brother, Dr. E. Hopkinson, published a Paper in which the results of experiments on a dynamo machine were first fully and quantitatively accounted for. Dr. Hopkinson was elected a Fellow of the Royal Society in 1878. He is a member of the Senate of the London University, is a member of the Council of the Institute of Mechanical Engineers, and was President of the Institution of Electrical Engineers for 1890. In this year also one of the Royal Medals was awarded him by the Royal Society.

HOUGHTON, Edward John, M.I.E.E.
Born in Kent in the year 1844; educated at Milton College, the Birkbeck Institution in London, &c.

Mr. Houghton entered the telegraph service of the London, Brighton, and South Coast Railway Company in his fourteenth year. The late Mr. E. G. Bartholomew, F.R.S., was then the telegraph engineer to the railway, and from him the subject of our notice received his earliest instruction in electricity. Mr. Bartholomew left the Brighton Railway, and was succeeded by Mr. Edward Cripps, to whom, in 1869, Mr. Houghton became assistant. He acquitted himself in this position so satisfactorily that upon the death of Mr. Cripps, in 1875 he was appointed electrical engineer to the company, which position he still retains. Mr. Houghton has done some good work, and has patented an electrical "tunnel alarm," "single-needle sounder," a "system of working single needle-speaking instruments without batteries at intermediate stations," a new "block signalling system," and, in conjunction with the locomotive engineer to the railway, has invented a system of electric lighting for trains. Mr. Houghton has had much experience in electric lighting generally, the fitting up of ships, trains, &c., with the incandescent system, and buildings with arc lights. He has been continuously working with electric accumulators since their introduction into this country by Messrs. Faure and Philippart and Major Ricarde-Seaver. It is largely owing to his perseverance that the electric lighting of trains is coming into vogue.

HOUSTON, Prof. Edwin J. Born at Alexandria, Virginia, U.S.A., July 9, 1844.

Prof. Houston is one of the inventors of the Thomson-Houston electric lighting system, now in extensive use, and has taken out numerous patents for electrical inventions, both conjointly with Prof. Elihu Thomson and individually. He acts as an expert in electrical patent cases in the United States law courts. In 1884 he was appointed a member of the United States Electrical Commission, and the Franklin Institute of the State of Pennsylvania chose him as chief electrician of its International Electric Exhibition, and was elected to preside over Section C of the Chicago Electrical Congress in 1893. He is Professor of Natural Philosophy and Physical Geography in the Central High School of Philadelphia, and Professor of Physics in the Franklin Institute of the State of Pennsylvania, and President of the American Institute of Electrical Engineers. Prof. Houston is the author of "Elements of Physical Geography," "Elements of Natural Philosophy," "Easy Lessons in Natural Philosophy," "Elements of Chemistry," "A Short Course in Chemistry," "The Telephone," "A Dictionary of Electrical Words, Terms and Phrases," "Primers of Electricity," "The Electric Transmission of Intelligence," "Electric Measurements," and "Electricity and Magnetism." He is one of the editors of the *Journal* of the Franklin Institute, and is a frequent contributor to scientific periodic literature, especially in the domain of theoretical and applied electricity.

HOWELL, J. C., was born at Llanelly in the year 1859, and was educated at home and at the Independent College, Taunton.

He was trained as an engineer in his father's business, and in the early part of 1882 turned his attention to the electric light, and shortly afterwards became sole agent for South Wales for Messrs. Crompton and Co. Several important installations were erected by him in collieries and tinplate works during that and the following years. During this period Mr. Howell began the study of storage batteries, and being convinced that for electric distribution on anything like a large scale storage batteries having a high capacity discharge rate were absolutely necessary, he worked out and patented a system of producing porous lead plates of very extended surface which could be formed on the old Planté method. In 1886 the demand for accumulators had grown to such an extent that it was found necessary to form a company to exploit the manufacture, Mr. Crompton taking a prominent part in the formation of the new company, the works in South Wales being under the immediate management of Mr. Howell himself. Large batteries under Mr. Howell's patents have been supplied to the leading electrical supply companies of London who work under the low-tension system, notably the Kensington and Knightsbridge Electric Lighting Company and the Westminster Electric Supply Corporation.

HUGHES, David Edward, F.R.S., &c.
Born in London, May 16, 1831.

During the year 1838 Mr. Hughes's parents emigrated to the United States, where, in the year 1850, he attracted so much attention by his musical talents that Herr Hast, an eminent German pianist in America, procured for him the professorship of music in the College of Bardstown, Kentucky. Mr. Hughes entered upon his academical career at Bardstown in the above-mentioned year, and at the age of nineteen he appears to have displayed an equal aptitude for physical science and mechanics, for upon the Chair of Natural Philosophy becoming vacant, the college authorities, knowing his proficiency in the subject, offered it to him. It was here that Prof. Hughes commenced the development of his design of the printing telegraph which bears his name. In 1853 he removed to Bowlingreen, in Warren Co., Kentucky, and

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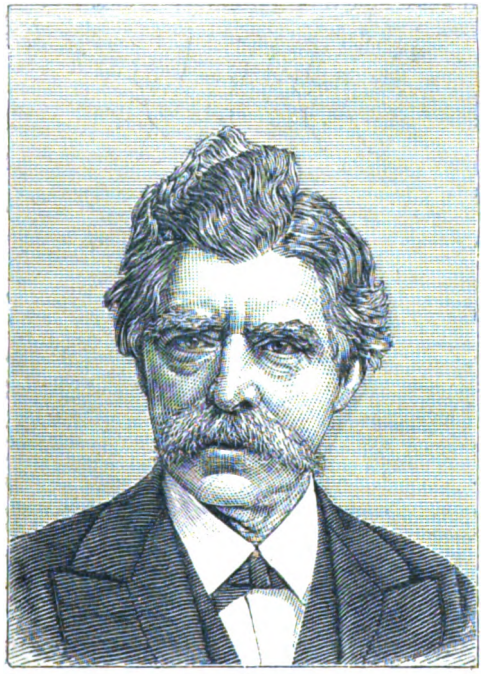

DAVID EDWARD HUGHES.

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acquired more freedom by taking pupils. The main principle of his type-printer was the printing of each letter by a single current, the Morse instrument, the only rival then in the field in America, requiring an average of three currents for each signal. In 1854 Prof. Hughes went to Louisville to superintend the making of his first instrument, but the patent for it was not taken out in the United States until 1855. In that year the invention may be said to have become a practical success, and no sooner was this the case than Prof. Hughes received a telegram from the editors of the *American Associated Press*, summoning him to New York. The American Telegraph Company was then in possession of the Morse instrument, and levied rates for transmission which were felt to be excessive. The Hughes type-printer was therefore taken up in opposition to the Morse, a company was formed, and the lines of several small companies—among which was the Western Union—were leased. In 1857 these smaller companies united to form one large corporation—the present Western Union Telegraph Company. In that year Prof. Hughes, leaving his instrument in the hands of the Western Union, came to England in order to effect its introduction here. He endeavoured to induce the then Electric Telegraph Company to adopt it, but with such ill-success that in the year 1860 Mr. Hughes went over to France, where he met with a much more encouraging reception. The French Government agreed to give the instrument a year of practical work on the French lines, and if found satisfactory it was to be finally adopted. It proved a thorough and complete success, and Prof. Hughes was constituted by Napoleon III. a Chevalier of the Legion of Honour. In 1862 Prof. Hughes went to Italy, where a commission was appointed, and a period of probation—six months—had to expire before the instrument was taken over. From Italy he received the Order of St. Maurice and St. Lazare. In 1863 the United Kingdom Telegraph Company introduced the type-printer in their system. In 1865 Prof. Hughes proceeded to Russia, and in that country his invention was adopted, after six months' trial, on the St. Petersburg-Moscow circuit. He was there created a Commander of the Order of St. Anne. Two years later he also went to Berlin, and introduced his apparatus on the Prussian lines. 1867 found him on a similar mission in Austria, where he received the Order of the Iron Crown; and in Turkey, where the then Sultan bestowed upon him the Grand Cross of the Medjidie. In the same year he was awarded at the Paris Exhibition one of the ten gold medals designed to mark the very highest achievements in science. In 1868 he introduced his apparatus into Bavaria and Wurtemburg, where he obtained the Noble Order of St. Michael. The following year witnessed its adoption in Switzerland and Belgium, and in 1875, upon visiting Spain, Prof. Hughes was made a Commander of the Royal and Distinguished Order of Carlos III. We have also to thank the eminent subject of our memoir for the microphone and the beautiful and ingenious apparatus known to science as the induction balance. Prof. Hughes represented Great Britain as one of the Commissioners at the Paris Electrical Exhibition, 1881, he was also elected president of one of the sections of the International Congress of Electricians, and made Commander of the Legion of Honour. He was elected Fellow of the Royal Society soon after his discovery of the microphone, and was President of the Society of Telegraph-Engineers and Electricians in 1886. The last few years he has made special researches upon the cause of magnetism, and has given several important Papers upon this subject to the Royal Society. The Royal Society, with the assent of the Queen, awarded in November, 1885, the Royal Medal to Prof. Hughes for his electrical and magnetic researches, and for his invention of the microphone and induction balance. In 1889 he was elected Manager of the Royal Institution of Great Britain, and in 1891 made Vice-President of the same Institution.

JABLOCHKOFF, Paul. Born at Serdobsk (Government of Saratow) on the 14th of September, 1847.

M. Jablochkoff belongs to a distinguished and well-to-do family. His father was a municipal councillor and a member of the General Council of his province. His younger brother was, at the age of twenty-eight, a lieutenant-colonel in the Engineers, and took part in Skobeleff's expedition into Central Asia. M. Jablochkoff studied at the Military Engineering College at St. Petersburg, which he left in 1866. As he manifested scientific tastes he was then sent to the Military Galvano-Technical School. His military service lasted five years, and in 1871, his particular aptitude for electricity having been noticed by his superiors, he was appointed director-general of the Moscow-Koursk telegraph lines. It was while he occupied this post and had the telegraph workshops at his disposal, that M. Jablochkoff began to take a deep interest in the subject of electric lighting. In the year 1872, the Nihilist propaganda first began to inspire terror, and when the Emperor travelled by rail it was decided to light up the track in front of the engine by means of an arc light. M. Jablochkoff was responsible for the lighting on the Moscow-Koursk section, and the frequent failures of the apparatus then employed induced him no doubt to consider all possible means of improvement. In 1875 he quitted the Imperial Telegraph Service, and has since then devoted his time exclusively to scientific pursuits. Passing through Paris on his way to the Philadelphia Exhibition of 1876, M. Jablochkoff was so pleased with what he saw of that city that he never got any further on the road to Philadelphia. At this time there was being held in London an Exhibition of Scientific Apparatus, and M. Bréguet sent M. Jablochkoff to London to represent that well-known firm. On his return to Paris, the Bréguet workshops were placed at M. Jablochkoff's disposal. Eight months of experimental work resulted in the famous "Jablochkoff candle." This discovery gave an immense impetus to electric lighting. A company was

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formed to work the patent, and in May, 1878, a magnificent row of Jablochkoff candles lit up the Avenue de l'Opéra at Paris. The Jablochkoff system of lighting soon spread, and before long "electric candles" were burning at Rome, and on the Thames embankment in London. The "electric candle," however, is by no means M. Jablochkoff's only claim to fame, as the following list of patents taken out by him will show:—(1) The Electric Candle; (2) The Distribution of Currents by means of Induction Coils; (3) An Incandescent Kaolin Lamp; (4) The Distribution and Division of the Electric Current by means of Condensers; (5) A Voltaic Battery consuming Coal; (6) An Alternate-Current Dynamo; (7) A Sodium Battery; (8) Auto-accumulators. Patent No. 2, as is well known, has been held to be the master patent for transformer distribution, and the system patented in No. 4 was at work at the Paris Exhibition in 1878.

JACKSON, Col. R. Raynsford. Born in 1823. At the age of seventeen Col. Jackson entered the cotton mills, at Blackburn, established by the late Sir William Feilden, Bart., a family connection of Colonel Jackson's, and was eventually taken into partnership, the proprietorship subsequently devolving upon him by the death of Sir William and the retirement of Colonel Feilden. Early in 1881 Colonel Jackson turned his attention to the telephone, and became the chairman of the National Telephone Company upon its formation. Upon the amalgamation of his company with the United Telephone Company and the Lancashire and Cheshire Telephone Exchange Company, he became a vice-president of the new National Telephone Company, of which he is still a Director.

JAMIESON, Prof. Andrew, M. Inst. C.E., F.R.S.E., &c. Born at the Manse, Grange, Banffshire, September 18, 1849; educated at The Gymnasium, Old Aberdeen, and Aberdeen University.

He served a complete apprenticeship to engineering, 1864-70, with Messrs. Hall, Russell and Co., Aberdeen Ironworks, under Mr. Thomas Russell; gained a Whitworth Exhibition; for some time draughtsman with the Great North of Scotland Railway; appointed, in 1873, as an assistant to Sir William Thomson and Prof. Fleeming Jenkin, in connection with the manufacture of the Western and Brazilian and Platino-Brazilian Companies' cables; accompanied the cable expedition in the end of 1874 to South America, and remained there as chief assistant electrical engineer to the telegraph companies until July, 1876. On his return to this country he was sent out by the Eastern Telegraph Company to the Mediterranean as electrician, his first duty being that of attending to the Muirhead duplex system of the Marseilles-Malta cable. From the beginning of 1877 until July, 1880, Mr. Jamieson took a leading part in most of the Eastern Telegraph Company's cable expeditions, visiting all the more important stations between England and India, the East Coast of Africa, and the Grecian Archipelago, localising faults, effecting repairs in as well as laying new submarine and subterranean lines, instituting and adjusting duplex working, and lecturing on submarine telegraphy to the different staffs at Porthcurnow, Malta, Alexandria, and Aden. During the exciting times of the Russo-Turkish War Mr. Jamieson had charge, as electrician, of the expedition carried out by the ss. "John Pender" and ss. "Great Northern," of connecting the British fleet lying off Princess Islands, Lampsaki, and Besiki Bay, by cable with the main system of the Eastern Telegraph Company, thus enabling orders to be sent direct by wire from the Admiralty in London to the commanding naval officers in the East. In July, 1880, Mr. Jamieson was appointed Principal of the Glasgow College of Science and Arts, in 1887 Professor of Engineering in the Glasgow and West of Scotland Technical College, and in 1893 he agreed to confine his lectures and laboratory work to Electrical Engineering, since both the number of his students and the range of the subjects taught had increased so much. Many of his students have been very successful in the Whitworth and National Scholarship competitions, and at the B.Sc. examinations at Glasgow University. He has written several Papers for different societies upon the subjects of "Lightning Protectors for Submarine Cables," "Cable Laying, Repairing, and Working," "The Action of Selenium in the Bell Telephone," "The Technical Education of Engineers, Shipbuilders, and Artisans," "The Fall of Resistance and Ratio of Candle-power to Electrical power spent in the Incandescent Lamp," "Electric Lighting in Steamships" (for which Paper he received a Telford premium from the Institution of Civil Engineers), "Electrical Symbols, Nomenclature and Notation," "Designing of Continuous Current Dynamo Machines" (for which Paper he received the James Watt Medal from the Institution of Engineers and Shipbuilders in Scotland), "The Insulation Resistance of Electric Light Installations," "Fire Risks due to Defective Installations of Electric Lighting and Defective Lightning Conductors," "The Electric Lighting of Public Buildings" (for which Paper he received a prize of books from the Institution of Engineers and Shipbuilders in Scotland), "Brown's New Rotary Expansive Engine," with results of brake horse-power tests, and of indicator diagrams, &c., on "Comparative Tests of Hellesen and E.C.C. Dry Battery Cells," and on the "London Electrical Engineering Laboratories," &c. (read at the Chicago International Congress of Electrical Engineers). He is author of the electrical engineering appendix to Prof. Rankine's "Rules and Tables," joint author of Munro and Jamieson's "Pocket Book of Electrical Rules and Tables," and author of two text-books "On Steam and Steam Engines," "On Magnetism and Electricity," and "On Applied Mechanics, for Electrical and Engineering Students." Prof. Jamieson has taken out several patents, including an automatically-acting self-relieving submarine cable grapnel, whereby rocks are cleared, but the cable hooked; a preventive against the action of the teredo-worm on submarine cable core; duplex

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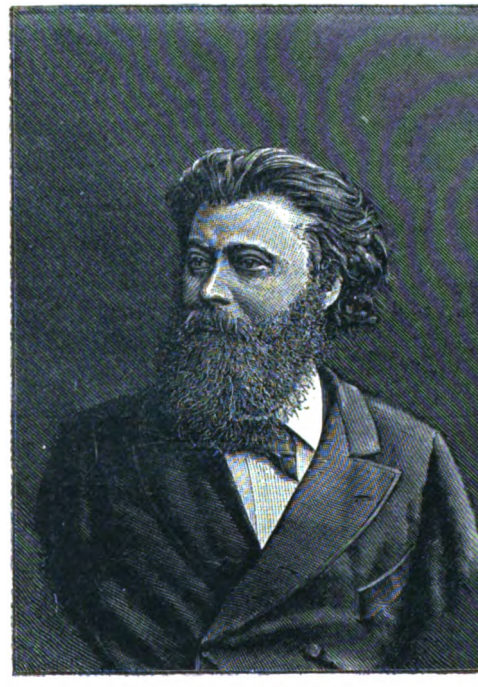

PAUL JABLOCHKOFF.

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machinery for raising and laying submarine cables ; an electrical governor for steam engines ; a graded galvanometer, for avoiding the necessity of using shunts when taking insulation and other electrical tests ; a tubular marine boiler ; and a means of insulating the copper strip conductors of underground mains. A large number of steamers, houses, and buildings have been lighted by the electric light to his specifications and under his supervision. He designed the Thomas Russell Memorial Experimental Steam Engine for the Glasgow and West of Scotland Technical College.

JEHL, Francis. Born in New York in 1860, and was educated in the Grammar School No. 19. In the year 1875 he entered Cooper's Institution, in New York, where he studied Chemistry and Natural Philosophy.

Mr. Jehl was afterwards employed at the Western Union Telegraph Company's works, where Mr. Phelps was director. Here, however, he did not remain long, as he had an opportunity of going to Mr. Edison, at Menlo Park, New Jersey. On the establishment of Mr. Edison's machine works in New York, Mr. Jehl had charge of the testing department, and took part in the first installations. He afterwards paid visits to England, France, and Italy, for the purpose of constructing and making known the Edison electric light meter in those countries. The Société Electrique Edison were just then about to instal their works at Ivry-sur-Seine, and Mr. Jehl accepted a position with them, and helped in the starting of the works. In 1882 he was sent to Brünn to instal the new theatre. It may be mentioned that this was the first theatre that was completely lighted by electric light, and had not a single gas jet. He also installed the National Theatre and Palais Royal, in Bucharest, Roumania ; in fact, he carried on all the work for his company in Eastern Europe. He is joint inventor with Prof. Rüpp of the Faraday disc dynamo, electric meter, automatic regulator system of continuous transformers, &c.

JOHNSON, W. Claude, M.I.C.E., F.R.A.S., &c. (of the firm of Johnson and Phillips, Engineers and Electricians, Charlton).

At the age of seventeen Mr. Johnson became an articled pupil of Mr. W. F. Gooch, C.E., and after serving a five years' apprenticeship in the locomotive works of the Vulcan Foundry Company, in Lancashire, he joined the Applied Science Department at King's College, London. In 1869 he became assistant to Mr. H. Clifford, the engineer of the Telegraph Construction and Maintenance Company's works. It was here, in working out designs for improved cable machinery, under the immediate supervision of Mr. Clifford, that he obtained a clear insight into the most advanced form and construction of this important branch of engineering, and his keen observation had ample scope in the direction to which his abilities so conspicuously tend, viz., in the design and construction of machinery. He was subsequently engaged on the engineering staff of that company in laying the original cables, then called the British Indian, to Bombay, &c. In the following year he proceeded to the East Indies to assist in the laying of the first cables to Singapore, Java, &c. In 1872 he was appointed chief engineer in the expedition commanded by Captain Halpin, in laying the cables to Port Darwin, in Australia, and which connected the Eastern Extension Company's system with South Australia, *vid* the land lines which had just then been completed across that continent. In 1875 Mr. Johnson left the Telegraph Construction Company to join Mr. S. E. Phillips in establishing the now well-known firm of Johnson and Phillips. During the past seventeen years this business, which has its works at Charlton, in Kent, has grown to be one of the leading firms in electrical engineering, the works covering several acres of land, and generally employing between 300 and 400 workmen. On the death of Mr. Phillips in 1893 Mr. Johnson became the sole proprietor of the business.

JOYCE, Samuel, Jun., born in London, August 22, 1863, and educated at Barnet Grammar School.

In 1882 Mr. Joyce became an assistant in the Testing Department of Messrs. Paterson and Cooper. In 1884 he was appointed manager of their Instrument Department, which post he held till the summer of 1891. During this time he greatly improved the process of manufacture and calibration of the numerous instruments ; and also invented the dead-beat ammeters and voltmeters made by the firm ; among which, those ammeters for very large currents have been much used in electro-chemical work. When a student of the Institute of Civil Engineers Mr. Joyce obtained a Miller Prize for a Paper on Electrical Measuring Instruments. He is an Associate of the Institution of Electrical Engineers and a member of the Physical Society. In the summer of 1891 he left Messrs. Paterson and Cooper, and was appointed to the post of Assistant Lecturer and Demonstrator in the department of Physics and Electrical Engineering of the Municipal Technical School, Manchester.

KAPP, Gisbert. Born at Mauer, near Vienna, in September, 1852 ; entered the Polytechnic School in Zurich in 1869, where he was a pupil of Zeuner and Kohlrausch, and gained the diploma of mechanical engineer.

After working for some time in an engineering works in Germany, Mr. Kapp was appointed a member of the engineering staff at the International Exhibition in Vienna, in 1873 ; and in 1875 he came over to this country, where he obtained employment at the works of Messrs. Gwynne and Co. Having spent a few years in travelling on the Continent and in the North of Africa, Mr. Kapp came back to England in the beginning of 1882, and then met Mr. Crompton, who appointed him engineer to the Chelmsford works. In the spring of the same year these two gentlemen invented their system of compound winding for dynamos. About a year later Mr. Kapp invented a class of electrical measuring instruments now well known under the name of Current and Potential Indicators,

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where permanency of calibration is obtained by the use of over-saturated electro-magnets. Mr. Kapp has, jointly with Mr. Crompton, taken out several patents, amongst which may be mentioned those for compound winding for dynamos; for instruments for measuring electric currents and electromotive force; for an electricity meter, and for improvements in dynamos. He also has taken out patents for making dynamos self-regulating without using two circuits on the field-magnet; for a self-regulating arc-light dynamo; for an alternate-current dynamo; for a high speed steam engine; for a system of alternate-current distribution ensuring constant pressure throughout an extended district; and for a transformer, the latter patent jointly with Messrs. Snell and Kent. In the spring of 1885 Mr. Kapp dissolved his connection with Messrs. R. E. Crompton, and brought out dynamos of his own, which are being manufactured under licences by Messrs. W. H. Allen and Co., of Lambeth, by Messrs Johnson and Phillips, of Charlton, by Messrs. Laurence, Scott and Co., of Norwich, and Mr. F. M. Newton, of Taunton. Since 1888 he has been practising as a consulting engineer on his own account. He was a frequent contributor to some German periodicals, to *The Electrician* and to *The Engineer*, and in May, 1886, he accepted an appointment as London editor of *Industries*, which he resigned in October, 1889. In 1885 he read a Paper before the Institution of Civil Engineers on "Modern Dynamos and their Engines," which received a Telford premium and medal; in June, 1886, his book on "Electric Transmission of Energy" was published in the "Specialist Series," and the fourth edition of this book is now going through the press. In November, 1886, he read a Paper before the Society of Telegraph-Engineers and Electricians on "The Predetermination of the Characteristic of a Dynamo," and in 1888 a Paper on Alternate-Current Transformers. In the beginning of 1889 he read a paper on "Alternate-Current Machinery," before the Institution of Civil Engineers, which was awarded a Telford premium and medal, and which was, by the permission of the Institution, republished in Van Nostrand's *Engineering Magazine*, New York. In the spring of 1891 he gave three Cantor Lectures on Electric Transmission of Power at the Society of Arts. He has also lectured at the School of Military Engineering on electric tramways and alternating currents In 1893 he published a book on "Dynamos, Alternators, and Transformers." Mr. Kapp is a Member of the Institution of Civil Engineers and a Member of the Council of the Institution of Electrical Engineers.

KELVIN, The Right Hon. Lord (Sir Wm. Thomson). Born at Belfast on June 25, 1824.

Though Irish by birth, Lord Kelvin's family is evidently of Scotch extraction, and belonged to that industrious race of Scotch-Irish farmers who live in peace and try to make the most of their holdings. In 1832 his father, Professor James Thomson, was appointed to the Mathematical Chair of Glasgow University, and earned a wide reputation both as a teacher and as an author of text-books on Mathematics and Arithmetic. His son William entered his class at Glasgow when he was eleven years of age, and was a great favourite with the students on account of his extraordinary quickness in solving the problems asked in the class. He was sent by his father to St. Peter's College, Cambridge, where he graduated as second wrangler and first Smith's prizeman in 1845. A wranglership can be taken by dint of study and facility in applying rules; but the Smith's prize is a kind of consolation stakes to genius. It is a test of originality and inborn mathematical power. While at Cambridge Thomson was no mere bookworm, but took an active part in field sports and athletics; he was a skilled oarsman, and won the Colquhoun silver sculls. He took an interest at that time in classics, general literature, and music, mainly through the influence and example of his father, who was a most cultured and well-informed man, and from whom he received the most, if not all, of his earliest instructions. But electricity and mathematical physics laid their hold and spell upon him, and soon absorbed all the teeming energies of his brain. He began to publish original investigations in mathematics at the age of seventeen, an age when most boys only thirst to learn, and do not dream of giving forth new truths. At twenty-two he was appointed Professor of Natural Philosophy in Glasgow University, an act which shows the confidence in his future which he had already inspired. One of the Tutors of St. Peter's College wrote at this time:—"He is regarded here by the most competent judges as the first man of science, of the rising generation, in this country." Lord Kelvin has repaid this confidence by continuing to associate himself with Glasgow in spite of many temptations to remove to Cambridge and elsewhere. In Glasgow he is a great figure, and its citizens are justly proud of him. We need not narrate all the incidents of his career, nor tell the titles of all his important Papers on science. It must be remembered that his mind has been extraordinarily prolific of investigations in all branches of physics, but especially in the domains of heat, electricity, and dynamics. His great work on Natural Philosophy—undertaken with Prof. Tait—is an unfinished monument to his mathematical ability. His researches on heat have ranked him with Joule and Clausius. It is, however, with his electrical work that we have chiefly to do; and with the practical part of that. To most people his elaborate mathematical investigations into the nature and laws of electricity are a sealed book; but when they yield some formula which is of great practical utility they come within the scope of general interest. Such is his law of the velocity of electric signals through long submarine cables, a law which showed how cables, across the Atlantic or any ocean, however wide, could be worked. Lord Kelvin followed up this law by the invention of the "mirror galvanometer," an ingenious and beautiful instrument whereby the electrical signals through a long submarine cable could be easily read at the other end of

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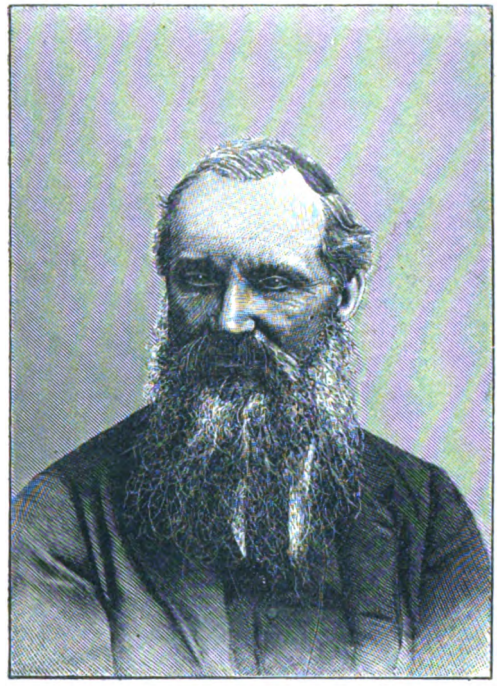

LORD KELVIN.

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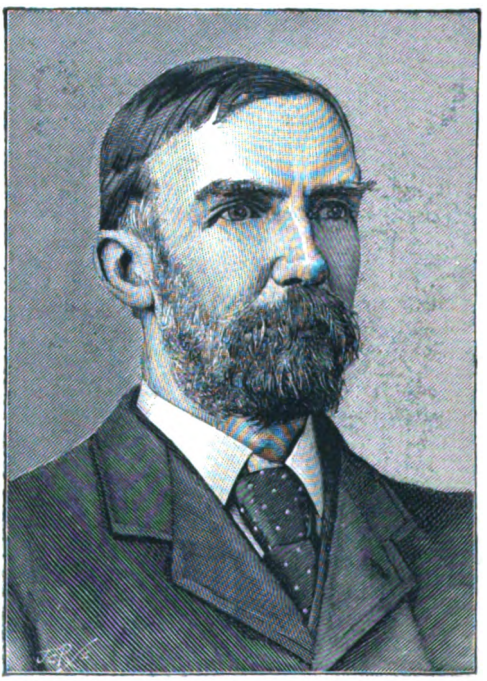

A. B. W. KENNEDY.

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the cable. This instrument rendered the early Atlantic cables economical in working. He obtained the honour of knighthood from Her Majesty, in 1866, along with Sir James Anderson and Sir Charles Bright his colleagues on the first wholly successful Atlantic cable expedition. He was raised to the peerage in January, 1892, taking the title of Baron Kelvin, and a suitable honour was thus conferred upon one to whom electrical and engineering science is so deeply indebted. The connection of Lord Kelvin with the early Atlantic cables determined his genius in a new direction. Henceforth, he gave much of his time to invention; and, after all, the best value of science lies in its application to the bettering of human life. If Lord Kelvin has found out fewer general laws than he might have done, he has given us a number of very useful instruments which enable us to telegraph from continent to continent. His siphon recorder improves upon his mirror galvanometer by writing down the message through long cables instead of flashing it to the eye; his tidal harmonic analyser and tide predictor calculate the height of future tides at any place; his electrometers have greatly assisted electrical measurements; and his new compass is the best in the market. His introduction of pianoforte wire for deep-sea sounding gave valuable aid to submarine cable laying; and his navigational sounding machine is largely used in the Naval and Mercantile Marine. During the last ten years Lord Kelvin, has devoted much time and attention to the production of measuring instruments for electric light purposes. His standard balances are well known and appreciated; and his newer electrostatic potential instruments and electro magnetic voltmeter and ampere meter are to be found in many electric light installations. Within the last two years a new electricity supply meter has been perfected by him, and it is now largely used in electricity supply stations, notably in that of the Corporation of Glasgow. His researches in electrostatics and magnetism were collected and published in one volume in 1872; while his collected mathematical and physical Papers, which he is now putting through the press, have already reached the third volume. Two volumes containing his collected "Popular Lectures and Addresses" have also quite lately been given to the public. The Jubilee prize of £100, given by Dr. Gunning, of the Royal Society of Edinburgh, was awarded to him for a "valuable series of Papers on hydro-dynamics," published early in 1887, and a continuation of these researches appeared in the *Philosophical Magazine* and the *Proceedings* of the Royal Society of Edinburgh. In November, 1891, Lord Kelvin was elected President of the Royal Society. It is unnecessary here to specify the numerous honours that have been bestowed upon Lord Kelvin, as the scientific associations and universities at home and abroad have vied in claiming him as an Associate, but we may mention that he is a Knight of the Order pour le Mérite of Germany, a Grand Officer of the Legion of Honour of France, a Commander of the Order of Leopold of Belgium, and a Foreign Associate of the French Academy.

KENNEDY, Professor A. B. W., F.R.S. Born March 17, 1847, at Stepney. Educated at the City of London School and the School of Mines, Jermyn-street.

Prof. Kennedy served as an engineering pupil for four and a-half years with Messrs. J. and W. Dudgeon, engineers and ship-builders, Millwall. In 1868 he became a leading draughtsman at Palmer's Engine Works, Jarrow; in 1871 chief draughtsman to Messrs. T. M. Tennant and Co., Leith; in 1872 he became consulting engineer in Edinburgh with Mr. H. O. Bennett, as Bennett and Kennedy. In 1874 he was appointed Professor of Civil and Mechanical Engineering at University College, London, the title of the Chair being changed later to that of Engineering and Mechanical Technology. He devised, in 1875, and shortly after established, the Engineering Laboratory at University College, which was the first of the kind in the country. In 1889, owing to the pressure of professional work, he resigned his Chair, but received the honorary title of Emeritus Professor of Engineering from the Council of University College. In 1876 he translated and edited Reuleaux's "Theoretische Kinematik" under the title of "Kinematics of Machinery," and in 1886 he published the "Mechanics of Machinery." Prof. Kennedy has been connected with the Research Committees of the Institution of Mechanical Engineers since their foundation, and as Reporter of the Committee on Riveted Joints carried out an elaborate series of experiments, which are published in the *Proceedings* of the Institution for 1881, 1882, 1885 and 1888. As Chairman of the Committee on Marine Engine Trials he has carried out also a number of extended and very complete trials at sea, the results of which have been published in the *Proceedings* of the Institute of Mechanical Engineers, 1889 to 1892. He contributed a Paper on "Engineering Laboratories" to the Institution of Civil Engineers (*Proceedings*, Vol. LXXXVIII., 1887), for which he was awarded a Telford medal and premium. Among his published experiments are the following:—Tests of the Griffin Gas Engine, the Beck Gas Engine, Easton and Anderson's Pumping Station at Addington, the Popp Compressed Air System in Paris (British Association, 1889, and *Engineering*, September, 1889); the Otto, Atkinson and Griffin Gas Engines, and the Davey-Paxman Steam Engine (Society of Arts Motor Trials, 1888); the Thornycroft Boiler (*Proc.* Inst. C. E., Vol. XCIX.); the Willans Central Valve Engine (*Proc.* Inst. C. E., Vol. XCVI.); the Thomson Electric Welding Process, &c. He has been, since 1878, largely occupied with the practical testing of materials of construction, and has fitted up for himself at Westminster a testing laboratory embodying the results of his experience in this work. He has also acted as engineer-in-chief to the Westminster Electric Supply Corporation (Limited) since its formation, and has designed the whole of its stations. He became a Member of the Institutions both of Civil and of Mechanical Engineers in 1879; in 1883 he was elected an Honorary Life Member of the latter, and is

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now President-designate. He is also a Member of Council of the Institution of Civil Engineers, and of the Institution of Electrical Engineers, and a Member of the Institution of Naval Architects, and of the Iron and Steel Institute. He was elected a Fellow of the Royal Society in 1887. He has designed electric lighting stations, which are now at work or in process of erection, for the Corporations of Glasgow, Oldham, Aberdeen, Belfast, Sunderland, and Edinburgh, and is a consulting engineer for several electric lighting companies.

KENNELLY, Arthur Edwin. Born in Bombay in 1861. Educated at University College School, London.

Mr. Kennelly commenced electrical work as assistant secretary of the Society of Telegraph Engineers in 1877. He entered the service of the Eastern Telegraph Company as clerk in 1878, serving at Porthcurnow and Malta. Placed as assistant electrician on board the s.s. "Great Northern" in 1880, he remained in that branch of the Company's service. In 1882, he was chief electrician of the s.s. "John Pender," subsequently acting in that capacity on the s.s. "Chiltern," "Retriever" and "Electra," in the Mediterranean and Red Seas, the Indian Ocean and Atlantic. In 1887 he received the premium of the Institution of Electrical Engineers for a Paper on a new method of localising faults in submarine cables, and the Fahie premium of the same Institution in 1889. In 1888, being then senior electrician of the ship staff, he resigned his position in the Eastern Telegraph Company, and became electrician in the laboratory of Mr. Edison at Orange, N.J. He has contributed a number of Papers to electrical journals, and among these his determinations of the carrying capacity of electrical conductors are the most generally known. Mr. Kennelly is a member of several scientific societies, one of the Vice-Presidents of the American Institute of Electrical Engineers and Chairman of its committee on "Units and Standards," an Associate Member of the Institution of Electrical Engineers, and consulting electrician to several corporations.

KIESER, Wilhelm. Born at Isny, South Württemberg, Germany, February 17, 1838; was educated in several good schools, and apprenticed in a manufactory of telegraphic, optical, and mathematical instruments at Stuttgart.

Mr. Kieser was afterwards engaged in the Federal Telegraph Manufactory under M. Hipp, in Berne, and when but twenty-three years of age came over to England. In 1863 the late Mr. Becker, manager to the firm of Elliott Brothers, directed the attention of Mr. Kieser to electrical science, and, under the guidance of the late Prof. Fleeming Jenkin, he was instructed to adjust the various resistances and arbitrary units for the British Association Committee. After being engaged in this branch of electrical work for twelve years, Mr. Kieser left the test-room to become manager of Messrs. Elliott's business.

KING, Frank, M.I.E.E. Born in London in 1854.

Mr. Frank King received a careful training at several private schools, and completed his education at Finsbury College. Mr. King commenced life in a comparatively humble position in the works of a well-known manufacturer of scientific apparatus, where he soon evinced a great aptitude for mastering details and then setting himself steadily to work to perfect what came under his notice. The practical results of this habit have been shown in his many valuable inventions. The introduction in 1881 of Faure's improved secondary battery led Mr. King to direct his energies to the subject of secondary batteries generally. Soon after his return from America, in the spring of 1888, Mr. King joined the Electrical Power Storage Company, taking the position of superintending engineer. He soon found congenial work in improving the "E.P.S." storage battery, and in the following year designed the well-known "1888" E. P. S. type of battery. Mr. King early turned his attention to the two great electrical problems—viz., traction and central station lighting, in both of which secondary batteries would be necessary or useful. In the former he has achieved success by the design and manufacture of the type of battery used on the Barking-road Tramways. With regard to central station lighting, Mr. King's system of automatic distribution as used by the Chelsea Electricity Supply Company has been in successful operation since the early part of 1889. The apparatus is a triumph of skill and ingenuity. The record of reliability is almost unique in the annals of central station lighting, as since its installation there has occurred no failure of the supply nor abnormal fall of pressure of the current in the mains of the Chelsea Company. At the close of 1889 Mr. King transferred his services from the Electrical Power Storage Company to the Electric Construction Corporation, taking up the same position of superintending engineer. Whilst he was with this corporation Mr. King introduced the new "K" type of E.P.S. storage battery, which is capable of being charged and discharged for short periods at four times the rate of the older types of lighting batteries, the normal maximum discharge being double the rate of the former. In 1891 the Electrical Power Storage Company resumed the manufacture of the E. P. S. batteries, under Mr. King's superintendence.

KITTLER, Prof. Erasmus, Ph.D. Born June 25, 1852, at Schwabach, near Nuremberg; educated at the Volksschule and at the Teachers' Seminary at his native place, and was afterwards a master at Nuremberg from 1871 to 1874.

After studying at the Gymnasium there, and afterwards in Munich and Wurtsburg, he passed his Doctor's examinations in mathematics and physics at the latter university in 1880. From 1879 to 1882 he was assistant to Dr. v. Beetz, at Munich, being appointed a Privat docent in 1881, and in 1882 he became professor of electrical engineering at the Grand Ducal Technical High

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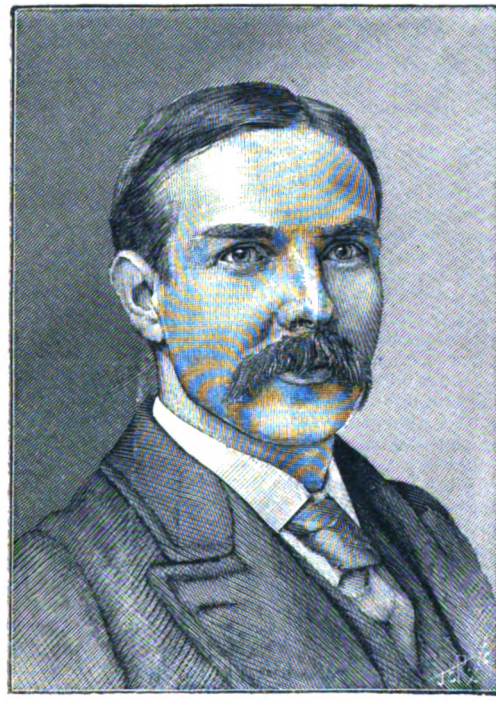

ARTHUR EDWIN KENNELLY.

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School of Darmstadt. From October, 1887, to October, 1889, Dr. Kittler was principal of this college, which has now attained great importance, and where in 1891 was constructed an extensive laboratory for electrical purposes. In 1882 and 1883 he was appointed vice-president of the technical scientific juries at the Munich and Vienna Electrical Exhibitions. In 1891 he was appointed president of the jury of the Electro-technical Exhibition at Frankfort-on-the-Main. In addition to the compilation of the "Handbuch der Elektrotechnik" (Handbook of Electrical Engineering) Dr. Kittler is engaged in the designing, examining, and partly superintending of central stations.

KNIGHT, Walter Harris. Born in 1858.

Mr. Knight was educated at Cincinnati University, taking a series of special courses in scientific subjects. He was occupied at various periods in assisting in the preparation of Knight's Mechanical Dictionary, a standard work of which his uncle, Mr. Edward Knight, was the author. From 1880 to 1883 he was Examiner in the department of electricity of the United States Patent Office, after which he associated himself with Mr. E. M. Bentley, with whom he has been connected in the development of the electric railway. In 1883-1884 he constructed, in Cleveland, Ohio, the first American electric tramway, using thereon the underground conduit system. Mr. Knight is at present engaged as engineer of the Railway Department of the General Electric Company.

KOHLFÜRST, Ludwig, retired chief engineer of the Buschtèhrader Railway, was born May 1, 1840, at Graz (Steiermark, Austria).

He attended the Real Academy and the Technical High School at Graz, and in 1862 entered the service of the Emperor Ferdinand Northern Railway as technical officer. A chance meeting with Mr. Hughes in 1867 resulted in his taking up the subject of railway electric telegraphs and signals, and he has since devoted himself to their improvement and development. He has published several Papers and short articles on the subject, amongst them being: "Entwurf einer Normal-Instruction für die Ansüburg des Telegraphendienstes bei Eisenbahnen," "Ueber elektr. Distanzsignale" (Prague, 1878), "Die elektr. Wasserstandsanzeiger" (Berlin, 1881) "Die elektr. Einrichtungen der Eisenbahnen" (Vienna, 1883), "Die Fortentwicklung der elektr. Eisenbahneinrichtungen" (Vienna, 1891), "Die elektrischen Eisenbahneinrichtungen auf der Frankfurter Ausstellung" (Stuttgart, 1892). He collaborated with Dr. Zetzsche in the preparation of Vol. IV. of the well-known "Handbuch der Telegraphie," which treats of railway telegraphs and signals, and for this in 1881 they received an honorary diploma at the Paris Exhibition, and in 1882 they were awarded a prize of M.1,500 by the Verein deutschen Eisenbahnverwaltungen, which society, in 1892, awarded Herr Kohlfürst a similar prize for his book "Die Fortentwickelung der elektr. Eisenbahneinrichtungen."

KOHLRAUSCH, Friedrich, Ph.D., was born in 1840 at Rinteln, on the Weser.

His father, Rudolf Kohlrausch, was the constructor of the first instrument for the measurement of low potentials. He afterwards made measurements of contact potentials, and gave the first experimental demonstration of Ohm's law. From 1850 to 1858 the father taught at the Polytechnic School at Cassel, and at the Universities of Marburg and Erlangen, and it was at these places that the son received his education. Even at this early age he was allowed to assist his father in many of his investigations, for example, in those concerning the electric residual charge. He also helped in preparing for the measurements made jointly by his father and Wilhelm Weber, particularly in the first comparison of the electromagnetic with the electrostatic unit, or the velocity "v" in Maxwell's theory. The father died in 1858, the year in which Friedrich entered the university. The latter studied physics under Beetz in Erlangen, but the greater part of his work was done under Wilhelm Weber in Göttingen. Here he received in 1863 the degree of Ph.D., having as the subject of his dissertation the elastic after-effect. For a short time after this he held the position of assistant in the Göttingen Astronomical Observatory. From 1864 to 1866 he was instructor in physics in the Physikalischer Verein at Frankfort-on-the-Main, and then returned to Göttingen to become Weber's assistant; he was also made privat docent and professor extraordinarius. From 1870 to 1871 Kohlrausch was professor in the Polytechnicum at Zürich, and from 1871 to 1875 in that of Darmstadt. He was then called to the University of Würzburg, where in 1879 a new physical laboratory was erected according to his plans. In 1888 he became professor at the Kaiser Wilhelm's University of Strassburg, which position he now holds. As a teacher Kohlrausch has always laid especial emphasis on the importance of practical physics. The first systematic course of instruction in this department he organised at Weber's suggestion in Göttingen in 1867. From this originated in 1869 his "Leitfaden der praktischen Physik," the pioneer among works of its kind. Besides the six German editions of this book there have appeared two English editions of a translation by Waller and Procter, and it has also been translated into French, Russian and Hungarian. In reviewing briefly Kohlrausch's more important contribution to science, special mention should be made of his work on elasticity, embracing a series of investigations concerning the elastic after-effect and the influence of temperature. He has also successfully applied the principle of total reflection to optical measurements. But the greater number of his scientific investigations refer to electricity and magnetism; they introduce new methods and new instruments for the observation and absolute measurement of the periodic and local variations of the earth's magnetic force; also for the absolute measurement of electrical current strength and resistance for scientific or technical purposes. These methods

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have been applied by Kohlrausch in his determination of the electro-chemical equivalent and to the absolute electrical resistance of mercury ("Determination of the Ohm"). For the measurement of the resistance of electrolytes he introduced alternating currents, using as an instrument of observation the dynamometer or the telephone. By means of this delicate method he has conducted numerous investigations concerning the conductivity of water and aqueous solutions of electrolytes; he has investigated the electromotive force of very thin gas films on the electrodes, and established the validity of Ohm's law for electrolytes. He has published theoretical investigations on the movement of the electrolytic ions, and on thermo-electricity. His writings have been published in the *Annalen der Physik und Chemie* of Poggendorff and Wiedemann, in the *Electrotechnische Zeitschrift*, and in the publications of the Berlin, Göttingen, and Munich Academies.

KOHLRAUSCH, Wilhelm Frdr., Doctor of Philosophy, Professor of Electrical Engineering at the Royal Engineering High School at Hanover, was born at Marburg in Hesse, May 14, 1855.

He studied at the Gymnasium at Hanover, and from 1874 to 1878 at the Polytechnic at Darmstadt and the Universities of Göttingen and Wurzburg, graduating as Doctor of Philosophy at the latter. In 1878 Kohlrausch was appointed second assistant to Prof. Kundt at the Physical Institute of the University of Strasburg, and in 1879 he was made first assistant. At Easter, 1883, he was chosen as special Professor for Theoretical Physics at the same University. At this time he had already devoted much attention to electrical matters, and had delivered many lectures on the subject. In 1884 he was appointed Professor of Electricity at the Royal High School of Hanover, a chair having then been founded for this branch of science. In July, 1892, he was appointed Rector for a period of three years. His treatises on the optics of crystals, acoustics, electricity and magnetism have been published in "Wiedemann," whilst his works in regard to the electrical measurements of dynamos, and others, have appeared chiefly in the *Electrotechnische Zeitschrift*.

KRAUSE, Rudolph Howard. Born in 1857. Went with his parents to Australia and the South Sea Islands; was sent to Germany to be educated, first entering the Grammar School in Bayreuth, and later the Moravian College in Niesky, Silesia, and returned to England after having completing his education in 1876.

Mr. Krause spent two years in the chemical works of Messrs. Howards and Sons, of Stratford, and in 1878 joined the original Edison Telephone Company of London, Limited, where he first occupied his attention with electricity, and took an active part in the first introduction of telephones in London. Some time later the United Telephone Company, Limited, took Mr. Krause into their service, and he acted for nearly a year as their secretary. He left this company to become secretary to the Edison Gower-Bell Telephone Company of Europe, and visited Belgium, Russia, and Austria in their interest; he also took an active part in forwarding the development of the exchanges in Lisbon and Oporto. He was appointed secretary to the River Plate Telephone Company, and filled that post to their entire satisfaction, but gave up both these appointments in 1883 at the request of the Consolidated Telephone Construction and Maintenance Company, Limited, in order to take the management of their numerous exchanges in Austria, which he had started, and which were transferred to the Telephone Company of Austria, Limited, of which company Mr. Krause acted as general manager. The greater portion of the Austrian telephone exchanges having been taken over by the Government on January 1st, 1893, Mr. Krause joined the Board of the Vienna Private Telephone Company as Managing Director. This Company owns the telephone exchanges of Vienna, with nearly 8,000 subscribers. He is a member of the Institution of Electrical Engineers, and their local hon. secretary and treasurer for Austria; a member of the Society of Civil Engineers and Architects of Austria, of the Electro-Technical Societies of Vienna and Berlin, and of several other scientific Societies.

LAISTER, James. Born 1837, at Burnham, Isle of Axholme, Lincolnshire. Educated at private school and City of London College.

For many years Mr. Laister was the Superintendent of the Post Office Telegraph Schools in London, a position which he had occupied from the time of the acquisition of the telegraphs by the State in 1871, at which period he took a prominent part in organising telegraphic instruction both in England and Ireland, to meet the large increase of force consequent upon the introduction of the shilling tariff. He had been previously in the employment of the Electric and International Telegraph Company, whose service he entered at a very early age. In October, 1889, Mr. Laister was appointed District Postmaster of Norwood, and in April, 1892, he became Postmaster of the Northern District of London. Mr. Laister is a member of the Institution of Electrical Engineers, and a contributor to various journals and magazines, both scientific and literary.

LANGDON-DAVIES, Charles. Born July 29, 1841, at Bristol. Educated by private tutors, receiving his early scientific training from the late Dr. David Mackie, F.R.S.E.

Accustomed to mark out his own course of study and to follow it alone, Mr. Langdon-Davies may be said to have been always more or less engaged in original research. Electricity was one of the subjects which early occupied his attention. About 1855 he turned his attention to the construction of a dynamo machine, but found that others were working on similar lines and obtaining similar results. In 1860 Mr. Langdon-Davies patented a self-acting printing machine, believed to have been the first apparatus which took up the material

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to be printed, piece by piece, and carried it through the entire operation without being touched by hand. A small example of the machine, which could be held on a man's palm, was exhibited at the Society of Arts, printing 12,000 cards an hour. It has since been preserved in the South Kensington Museum. This machine was the basis of the automatic card printing machines now in general use, and its feed apparatus has been adapted to much of the automatic machinery lately so popular. At the time of the conversion of the old copper into the new bronze coinage, Mr. Langdon-Davies entered the service of the Royal Mint, where he devised an apparatus for counting the coins which was approved by Professor Graham, then Master of the Mint, who, in acknowledgment of these and other services, expressed his intention to promote Mr. Langdon-Davies to an important post in the establishment. He was, however, detailed for a time from the Royal Mint staff to assist in the organisation of the English Mint then projected for Hong Kong, and eventually elected to accept the post of Superintendent of the Bullion Office there, which was offered to him by the Secretary of State for the Colonies. After living for six years in China, where he established the *China Magazine*, he returned to England in 1871. In 1875 he worked out improved processes for preserving masonry and ironwork from decay, which are in successful use all over the world. The electric telephone next claimed Mr. Langdon-Davies' attention, but although numerous improvements were the result of his researches, the course adopted by the United Company led him to avoid the risk of litigation, by continuing his experiments abroad and afterwards by laying them aside until the end of 1892, when they were resumed. Mr. Langdon-Davies gave considerable attention to the phenomena of induction, and sought to overcome the obstacle to good telephones arising from the induction noises caused by telegraph currents passing in the neighbourhood of telephone conductors. Finding the difficulties great, he determined to try to turn that form of induction to some useful purpose, and invented the Phonopore. He has since designed a complete series of telegraph instruments on the phonoporic system for simplex, duplex, and multiplex telegraphy, all capable of being put in independent action on the same wire as that on which any ordinary electric telegraph is, at the same time, working. The phonoporic instruments form the subject of about a hundred patents. They are in practical use in many countries, and constitute the only multiplex system which really doubles the user of a telegraph wire. Mr. Langdon-Davies has for some years been investigating the retardation of currents in submarine cables with the view of elaborating a rapid submarine telegraph. He has also produced a new microphone induction coil, composed of a multiple primary of negligeable resistance, and a phonoporic secondary of practically infinite resistance. This is used on railway block signal wires for simultaneous telephonic communication, and it constitutes a very loud-speaking telephone for general use.

LAURITZEN, S.

Up to the year 1882, Mr. Lauritzen was the engineer of the Great Northern Telegraph Company at Copenhagen. He is the inventor of the undulator, a telegraphic receiving instrument in use on all the Great Northern Company's cables. Mr. Lauritzen is now a member of the firm of Kemp and Lauritzen, of Copenhagen.

LAVENDER, John, M.I.E.E., M.S.A.

Born at Lichfield, Staffordshire, 1829; educated at private schools.

He went to sea at an early age, and in 1850 joined the staff of the British Telegraph Company, which was formed to work Highton's patents, consisting of his one-wire system, worked by single-needle instruments, and his tapper keys. In these early days, owing to the monopoly conceded to the Electric Telegraph Company, the British Company were compelled to fix arms on poles in a cross-wise position, and to extend their wires in a similar way. Thus the top front wire on one pole would become the second front wire on the next pole, and so on, reversed at the third pole. The lines had to be constructed under these unfavourable conditions for some three or four years, and modern telegraphists can well realise the difficulty of discovering a "contact on the line." The insulation was effected by means of a silk ribbon passed round the line wire about 16in., and covered with a cone-shaped insulator of hot gutta percha. When this gutta percha was cold it was screwed down firmly to the end of the arm, and a coat of shellac varnish completed the appliance. In 1854 Mr. George Seward, the then secretary, negotiated for the purchase of the European Company's underground system. It consisted of six bare gutta-percha wires placed in a V-shaped trough and laid down between London, Birmingham, Macclesfield, Manchester, and Liverpool. In a very short time these wires completely failed, but the company having powers for turnpike-road work, Mr. Lavender, in 1858, constructed the first three sections of the overhead line from Manchester to London, viz.: Poynton two miles, Newcastle five miles, and Stoney Stratford three miles. Prior to this he had been engaged in the construction of the first line of telegraph ever erected on a turnpike road. In 1853 he was engaged in the construction of the line between Hull and Goole; while at Howdendyke he took a prominent part in the erection of lower and top masts to carry wires at a height of 140ft. above the level of the Humber. In 1854 Mr. Lavender inaugurated the over-house system by erecting wires which communicated between the Halifax Railway Station and a place of business in the centre of the town. In 1859 he superintended the over-house work in connection with the Ashton and Stalybridge Railway. Up to this time 60ft. and 70ft. poles had never been used; they would have been too costly. Mr. Lavender mastered the difficulty by the simple but ingenious contrivance of splicing 30 and 40ft. poles. In 1862 he erected the first over-house work in Manchester, carrying sixteen lines from Ducie Place to Salford Station, and

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eight wires from Ducie Place to Ardwick Green. In 1864 Mr. Lavender was engaged in over-house work first at Stockport and then at Newcastle, where 60ft. and 70ft. poles were first used. At Coventry he made the experiment of fixing the arms on one side of the poles only, and this system has since been generally adopted. After devoting sixteen years to over-house, underground, and other telegraphic lines, Mr. Lavender was appointed to take charge of the Leeds district. In 1867 he removed to Cambridge, where he had the entire control of the turnpike road lines between London and Doncaster, Cambridge and Cromer, and Norwich and Yarmouth. Shortly after the transfer of the telegraphs to the Government he was permitted to retire, and in 1872 he joined the Lancashire and Yorkshire Railway Company. After reconstructing the whole of this company's lines, he left the service in order to undertake the extensive electrical arrangements in the new Manchester Town Hall, and those of the West Lancashire Railway Company, the Euston Hotel, London, and innumerable smaller systems. At present Mr. Lavender, who resides near Manchester, is engaged in constructing and carrying out telegraph and telephone systems for the Mersey Tunnel Railway Company, Liverpool and Birkenhead, West Lancashire Railway Company, and other telegraph works. In addition to the above, he represents the firm of Messrs. John Birch and Co., merchants and engineers, of London, as electrician in Manchester.

LAWRENCE, H. Newman. Born in 1851. Educated at the Perse Grammar School, Cambridge, in which town he assisted his father in business for some years.

In 1883 Mr. Lawrence came to London and studied electrical science at the City Guilds Technical College, Finsbury, where he in due course obtained the Certificate in Electrical Engineering, and was placed first on the list for laboratory work. During his second year as a student he was appointed student-in-charge of the electric lighting of the college, and for two sessions following held the post of assistant-instructor in mathematics to the evening classes. On leaving college Mr. Lawrence became assistant and secretary to Mr. J. G. Lorrain, consulting engineer. In 1888 he founded, and was appointed Managing Director of, the Institute of Medical Electricity, which had for its object the development of electro-therapeutics by electricians and medical men conjointly. Mr. Lawrence is author of "A Handbook for Operators in Medical Electricity and Massage," "The Current that Cures," and a Paper on "The Human Body as a Conductor," read before the British Association, 1892. He is joint author of "Practical Lessons in Electro-Therapeutics," and the following papers: "Alternating *v.* Continuous Currents in Relation to the Human Body" (battery and coil currents), read before the Institution of Electrical Engineers in March, 1890; "Alternating *v.* Continuous Currents in Relation to the Human Body" (dynamo currents), read before the British Association in September, 1890; and "Electricity in Relation to the Human Body (its dangers and its uses)," read before the Society of Arts. Mr. Lawrence has invented and patented an electro-gymnastic apparatus, an electric douche, and an ozonised cabinet for therapeutic purposes. He has also, in conjunction with another, developed from its experimental to a practical stage the use of electric endosmose for medical purposes, and introduced a method of treatment based thereon under the title of "Cataphoric Medication," or the local administration of drugs through the skin. Mr. Lawrence is a member of the Institution of Electrical Engineers, a Fellow of the Imperial Institute, in 1891 founded and became first chairman of the Society of Operators in Medical Electricity and Massage, and in 1893 was one of five electrical experts elected Fellows of the American Electrotherapeutic Association.

LAWTON, George F. Born 1849. Educated privately in England by the Rev. G. Stokes, and in France.

Mr. Lawton was with the late C. F. Varley in 1868-9; then joined the Anglo-Mediterranean Telegraph Company. He was at Malta and on board the steamship "Hawk" till 1871; at Suez 1871-74, as assistant to Mr. H. A. C. Saunders, electrician-in-chief of the Eastern Company. He was subsequently attached to the steamship "Chiltern" from June to October, 1874. He went to Marseilles in December, 1874, introducing the first syphon recorder into France. Assisted Dr. Alex. Muirhead, Mr. J. Munro, and Mr. Herbert Taylor in the preliminary experiments and final adoption of the duplex system to submarine cables. He was appointed manager January, 1885. He is a member of the Physical Society of France.

LE FEVRE, W. H., Civil and Mechanical Engineer. Born at St. Peter's, in the Island of Jersey, in 1840; educated at Victoria College, and there took high mathematical honours; graduated at the University of London; articled to Mr. William Dempsey, C.E., of Great George-street, Westminster.

On the expiration of his term of articleship Mr. Le Fevre left for Africa, and was employed in the laying out and construction of the Algerian Railways system; subsequently the Tunis Railways and Gas Works and Egyptian Railways. Mr. Le Fevre also practised in Westminster as a parliamentary and railway engineer, and was engaged (amongst others) on the following railways and public works:—Cape Railways, Table Bay Harbour Works, Italian Railways, Great Indian Peninsula Railway, Victoria Railways, Jersey and Guernsey Telegraph, Herne Bay Waterworks, Buenos Ayres Railway, Bombay Gas Works, Welsh Coast Railway, Halesowen Railway, Mauritius Railways, and the Kurrachee Waterworks. Mr. Le Fevre was in partnership with Mr. R. M. Ordish, Mr. Carrington, and Mr. Robertson, and carried out the following works:—Amsterdam, Crystal Palace, International Exhibition (1862), Dutch-Rhenish Railways, Oporto Crystal Palace, Tudela and Bilbao Railway, Albert Bridge, Chelsea, Dublin Crystal

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Palace, Derby Market Hall, Rangoon Wharf, Prague Bridge, and Leeds Exhibition. He was for many years member of the Council of the Society of Engineers, and in 1867 was elected president, also honorary member of the Society of French and German Engineers. He has devoted much attention to aerial navigation; was elected a member of the Council of the Aeronautical Society of Great Britain, honorary member of the Académie d'Aérostation Météorologique de Paris, and is president of the Balloon Society of Great Britain.

LIEB, John W., Jun., graduated as Mechanical Engineer from the Stevens Institute, Hoboken, N.J., in 1880.

Spent six months as draughtsman in the works of the Brush Electric Company, Cleveland, Ohio. Entered the Engineering Department of the Edison Electric Light Company as draughtsman in 1881; transferred to the Testing Department and Experimental Laboratory of the Edison Machine Works in 1882; subsequently appointed by Mr. Edison to superintend the installation of the electrical plant in the first Edison Central Station in New York, and on the inauguration of its regular service was appointed its first electrician. In 1882-83 was sent to Milan, Italy, by Mr. Edison to direct the installation of the Milan Edison Station. On the organisation of the Società Generale Italiana di Elettricita Sistema Edison he was appointed chief engineer of the Company, and director of the Milan Stations; and for some years he directed the mechanical and electrical equipment of those stations, and the installation of the overhead and underground conductors supplying current on the Edison, Thomson-Houston, and Zipernowsky-Déri alternate current systems. Mr. Lieb is a member of the American Society of Mechanical Engineers, of the American Institute of Electrical Engineers, and of the Italian Society of Electricians.

LOCKWOOD, Thomas D. Born in Birmingham, December 30, 1848. Had a very slender school education to start with, and began work for a living in 1859.

His first employment was washing emery for use in the manufacture of plate glass at the Birmingham Plate Glass Works, after a year of which he entered the machine shops of the manufactory and worked there, learning and practising the trade of machinist, until 1865, when, with his father's family, he sailed for North America. He resided for some time at Port Hope, Ontario, Canada, where, after a short spell in the machine shop and tannery, he learned the art of telegraphy. He became the first operator at Port Hope for the Provincial Telegraph Company, a short-lived concern, afterwards swallowed up by the Montreal Telegraph Company. Thrown out of employment in 1867 by this consolidation, young Lockwood, unwilling to be idle, took the first work that offered, and became a finisher in the paper mills of the Smith Paper Company, of Lee, Mass. In 1869 Mr. Lockwood, ever on the watch for opportunity, went west to New Albany, Indiana, where he aided in the establishment of a manufactory of polished plate glass. This was the first concern of the kind in the United States, and Mr. Lockwood wrote the order to England for the importation of the first machinery used in that country for the purpose. This factory afterwards developed into the Star Glass Works where the late W. C. De Pauw made some of the millions with which he endowed so liberally the De Pauw University. It was at New Albany that Mr. Lockwood made his *début* in literature, by contributing to the *Scientific American* an excellent four-column article on the manufacture of plate glass. In 1872 Mr. Lockwood went east again, working his passage, and engaged in the employ of the Housatonic Railroad, serving consecutively as ticket clerk, freight clerk, and telegraph operator at Lee and Bridgeport, and as chief clerk and paymaster in the master mechanic's department, besides acting on trains in various capacities, from brakeman to engineer. Reaching New York in 1873, Mr. Lockwood engaged with the Automatic Signal Telegraph Company, a private fire alarm service, as inspector; and he was then called to positions of higher responsibility with the Gold and Stock and American District Telegraph Companies. At this time—1874 to 1877—these companies were the best schools of practical telegraphy and electrical application in the country, and Mr. Lockwood, always anxious to learn, proved an apt scholar. It was here that he gained the immense experience in the management and arrangement of circuits that made him invaluable when the telephone was introduced. One of the effects of the invention of the telephone by Prof. Bell was to drain the telegraphic field of many of its best and brightest spirits, and it was thus that, in 1879, Mr. Lockwood came to accept a position with the National Bell Telephone Company, which a little later organised as the American Bell Telephone Company. For some time he acted as technical inspector of exchanges, but in 1881 the company decided to organise a Patent and Technical Information Bureau, at the head of which Mr. Lockwood was placed. Here he was emphatically the right man in the right place. At the present time he has charge of the Patent Department of the American Bell Telephone Company at the headquarters in Boston, acts as one of the electricians of that company, and also as advisory electrician for the Bell Telephone Company of Canada, and for the Western Electric Company of Chicago and New York. It is needless to say that the duties of such positions involve the exercise of many rare and special qualities, and exact an unremitting attention to subjects of the utmost importance. One of the first of Mr. Lockwood's literary labours was the "Notes and Queries," published chiefly in *The Operator*. The next was a series of valuable articles specially relating to practical telephony, also published in *The Operator* and issued in book form as "Practical Information for Telephonists," which has had a large circulation. The third noteworthy production is the well-known "Text-Book of Electrical Measurements." Mr. Lockwood has also contributed to the technical journals innumerable

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articles, not simply on telephonic topics, but on subjects of general and vital interest to electricians at large. Besides working and writing, he has found time for a little inventing. He has taken out 22 patents in all, in 19 of which he appears as the sole inventor. All are for telephones and telephonic appliances but two, these latter being for a burglar alarm and a district system. It was also Mr. Lockwood who first applied the Wheatstone bridge system to the burglar alarm service. Mr. Lockwood is an honorary member of the National Telephone Exchange and National Electric Light Associations, and a foreign member of the London Institution of Electrical Engineers. In 1884 he was, by request, one of the authors of Papers read before the International Electrical Conference at Philadelphia. In the winter of 1885, he was lecturer before the Lowell Institute on telegraphy and the telephone. He was a charter member of the American Institute of Electrical Engineers, and has twice been vice-president of that Society.

LODGE, Prof. Oliver J., D.Sc., F.R.S., M.I.E.E. Born June 12, 1851, at Penkhull, near Stoke-upon-Trent.

Educated at Newport (Salop) Grammar School. He was at fourteen put into business with his father in the Potteries, and remained there for six or seven years. During this time he made his first acquaintance with science by reading an odd monthly number of the *English Mechanic*, and afterwards picking up what he could from the articles of the "Penny Cyclopædia." Later, while on a visit to London, he attended a private course on elementary chemistry. He then attended evening classes in chemistry under the Science and Art Department at the Wedgwood Institute, Burslem; and in 1872 was permitted a winter's course at the South Kensington Chemical Laboratory, on the annual examination list, of which he came out bracketed first. In 1871, by working at odd hours, he matriculated at the University of London, and after two years of private study passed the intermediate examination for a science degree. In this examination he obtained honours in chemistry and physics, standing alone in the first class in the latter subject. He next tried for a scholarship at St. John's College, Cambridge; but, not succeeding in getting nearer than *proxime accessit*, he went to study mathematics at University College, London, where Prof. Carey Foster enabled him to live without much home aid by teaching in exercise classes. In 1875 he took his B.Sc. degree; and the post of Demonstrator of Physics at University College was created and offered to him about the same time. In the same year he published, in conjunction with Prof. Foster, several Papers on the flow of electricity in a plane conductor, in which the forms of the lines of flow and equipotential lines are found practically and mathematically for various shapes of conductor, and for different positions of the electrodes. In 1876 he read and analysed the first volume of Maxwell's Electricity, and the same year he exhibited before the British Association a model, the purpose of which was "to illustrate mechanically the passage of electricity through metals, electrolytes, and dielectrics, according to Maxwell's theory." In June, 1877, he published a Paper describing a modification of Mance's method for measuring battery resistance, in which a condenser and galvanometer are used in place of the ordinary Wheatstone's bridge galvanometer. Later in the year appeared his suggestion for a standard Daniell cell, in which the copper sulphate solution is prevented from getting to the zinc rod either (1) by having to diffuse through a very long column of zinc sulphate; or (2) by connecting the two liquids by a fine capillary layer of sulphate of zinc. In the same year he took his degree of Doctor of Science, choosing Experimental Electricity as his special subject. In 1877 he became Assistant Professor of Physics at University College, and undertook lecturing duties; he was also Lecturer in Physics at Bedford College, London; and in addition to these appointments, he assisted the late Prof. W. K. Clifford in the Mathematical Department of University College, and wrote an elementary book on "Mechanics" for Messrs. Chambers. The original work of this period was an extended series of observations on the thermal conductivity of metals and crystals. In November, 1879, Dr. Lodge undertook the measurement of the resistance of some alloys of copper and tin made by Prof. Chandler Roberts. About this time the telephone and the Hughes induction balance came into prominence, and directed the attention of physicists more closely to the phenomena of self and mutual induction. Moreover, the article of Chrystal in the "Encyclopædia Britannica" shed a clear light on the subject, and obtained many new readers for the hitherto uncut pages of the second volume of Maxwell. Amongst other things, it led Dr. Lodge to publish a mathematical theory of intermittent currents and the induction balance. The facts observed by Hughes were here accounted for and somewhat extended. The effects of making and breaking a circuit were also discussed more fully than in Chrystal's article. But possibly the greatest value of the Paper lay in the fact that it familiarised students with the nature and action of self and mutual induction in closed circuits. In 1881 Dr. Lodge was elected to the Professorship of Physics and Mathematics at the new University College in Liverpool. During the greater part of the college session 1881-2 his time was occupied in superintending the construction and equipment of the Physical Laboratory. In addition to this he delivered all the courses of lectures both in Physics and Mathematics. At the end of a year the Chair of Mathematics was endowed, and Prof. Lodge was thus relieved of this part of his onerous task, retaining the Professorship of Physics, which he still holds. He then commenced a series of experiments to ascertain the behaviour under different circumstances of secondary cells with plates of various materials and with different liquids, and acted as scientific adviser to the Electrical Power Storage Company during the two years

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1884-86. In 1884 he took out a patent for the use of mercury sulphate along with zinc negatives in secondary cells. He likewise found, among other things, that plates of zinc and peroxide of lead in sulphuric acid gave a steady electromotive force of about 2·5 volts, the highest which he could obtain from any single practicable cell. He proved experimentally that the reason of the sudden drop in the E.M.F. of ordinary secondary cells was the scumming over of the negative plate with sulphate of lead. In the spring of 1883 Prof. Lodge secured the friendly co-operation of the late Mr. J. W. Clark as demonstrator; and in 1884 published, in conjunction with him, a Paper on the behaviour of dusty air near illuminated bodies. At the British Association Meeting at Montreal in 1884 he was chosen to deliver one of the evening discourses, and took for his subject "Dust." In addition to this he was one of the secretaries of Section A, and also opened the first formal discussion ever held in that Section. The discussion was "On the Seat of Electromotive Force in the Voltaic Cell." The discussion was followed a little later by a Paper from Prof. Lodge on energy paths in voltaic circuits, showing how Poynting's views enabled a clear statement to be made. After the success of the 1884 discussion Dr. Lodge established his reputation as a controversialist, and was asked to open a discussion on Electrolysis at the next (Aberdeen) meeting of the Association. In it he reviewed the state of electrolytic theories up to that date, and after the discussion took up the subject with a view to obtaining data for the rate of migration of ions in electrolysis. Indeed, during the years 1886-7 his experimental work was mainly devoted to the subject of electrolysis. In these two years a considerable portion of his time was taken up by the duties of the Electrolysis Committee, of which he was a secretary. For the 1886 Report he translated and reviewed several foreign memoirs on the subject. In the autumn of 1887 Prof. Lodge began his researches on waves in conductors and on Leyden jar discharges. The first experiments were described in the Dr. Mann Lectures, which were delivered before the Society of Arts in March, 1888. Since that time his experiments have proved that pulses travel along isolated wires with the velocity of light, and he has investigated the conditions indicated by theory and perfectly borne out by fact, under which an electrical discharge is oscillatory in character, and has shown that the case of a lightning discharge may, and in general does, satisfy those conditions. He has always emphasised the fact, first clearly published by Heaviside in the columns of *The Electrician*, that oscillatory discharges or impulsive rushes tend to keep to the outside of a conductor, and his most recent communication on the subject was mainly directed to showing how a closed conductor may be used to afford protection from a lightning flash to telegraphic installations. The interest of these experiments was greatly increased by the discussion at the British Association at Bath in 1888 on Lightning Conductors, in which Dr. Lodge again took a leading part. At the end of 1887 Prof. Lodge published in *Nature* his views on the ether theory, and the mechanics of the propagation of light and electricity. These articles were collected into a book, and issued in 1889, under the title "Modern Views of Electricity." In 1889 he applied his Leyden jar experiments to a measurement of the value of "*v*," the ratio between the electrostatic and electromagnetic units of electricity, working in the Cavendish Laboratory, Cambridge, in conjunction with Mr. Glazebrook. The clear, terse way in which Dr. Lodge sets forth his ideas and describes his experiments has awakened in the minds of many an interest in his work which the ordinary theorist finds himself unable to create. This lucidity of statements contributes greatly to his success as a controversialist, while in his college lectures it is especially felt and appreciated. Moreover, it makes him welcome everywhere as a writer or lecturer on scientific subjects. To his assistants his unceasing thoughtfulness, kindness, and sympathy render him something more than a friend. The quality and quantity of his work serve to place him in the very foremost rank of the younger School of Physicists. Dr. Lodge is one of the Examiners in Sound, Light, and Heat for the Government Science and Art Examinations, and has been elected an Examiner in Physics at the University of London, having previously (1876-79) held the post of Assistant Examiner. As Professor at one of the three constituent Colleges he is also an Examiner for Victoria University. In 1885 he was one of the jurors at the International Inventions Exhibition, and wrote for the official handbook a short article on progress in electricity during the past 25 years. In the spring of 1888 the University of St. Andrews conferred upon him the honorary degree of LL.D., and shortly afterwards he was admitted a Fellow of the Royal Society. He has been a member of the Physical Society since 1875, and is now a vice-president. He is also President of the newly-formed local Physical Society at Liverpool. In connection with the British Association, besides the offices already mentioned, he was one of the secretaries of Section A from 1878 to 1884, and has served on many committees. Prof. Lodge is also a Member of the Institute of Electrical Engineers. Moreover, he is interested in the subject of hypnotism, and has communicated Papers at various times to the Society for Psychical Research, of whose council he is a member. In 1891 he was President of Section A of the British Association, at Cardiff. His lectures at the Royal Institution have been on the deposition of dust and fume by electricity, on fuel and smoke, on the ether, on the Leyden jar, on aberration and the motion of the Earth through the ether. On the two last subjects he has communicated long memoirs to the Royal Society. Messrs. Whittaker have lately published, with the authority of the Society of Arts, Dr. Lodge's lecture on Lightning Conductors, together with much additional matter, and a Paper on Lightning Guards for Telegraphic Purposes, which he read to the Institution of Electrical Engineers. These guards are available for cables, for tele-

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phones and instruments generally, and for electric lighting circuits; and they are on trial in several important stations. Another book just published by Messrs. Macmillan is a series of studies in scientific history as illustrated by the lives and work of the great astronomers, called "Pioneers of Science."

LORRAIN, J. G., youngest son of the late Dr. W. B. Lorrain, M.D., a well-known physician and naturalist, and grandson of the late Dr. William Lorrain, M.A., LL.D., Head Master of the Glasgow Grammar School, whose revisions of the texts of Virgil, Sallust, and Ovid are still well known to classical scholars.

Mr. J. G. Lorrain commenced the study of engineering as pupil of Mr. Edward Sang, C.E., of Edinburgh, after which he became a pupil of Prof. Fleeming Jenkin, F.R.S. Studied at Edinburgh University for two years, obtaining "passes with distinction" in mathematics, physics, and mechanics. In 1871 went to University College, London, and studied there for 18 months, and then to the Royal School of Mines for three years, working chiefly at chemistry, mineralogy, mining, metallurgy, and geology. Afterwards went to Paris, and attended lectures at the College of France for two terms. Was then appointed chemist to the Oakbank Works, Midcalder, after which he started in private practice in Edinburgh. Mr. Lorrain erected the first telephone lines in Scotland, and in July, 1879, started the Manchester Telephonic Exchange—the first exchange formed in Europe—and soon afterwards the Liverpool Exchange. In November, 1879, Mr. Lorrain founded and was consulting engineer to the Scottish Telephonic Exchange, Limited (now merged into the National Telephone Company, Limited), for which company he established the Edinburgh, Dundee, and Belfast Exchanges. In 1880 he founded and was consulting engineer to the Anglo-Indian Telephone Company, Limited—the pioneer telephone company in India—which company soon afterwards amalgamated with the Bell and the Edison syndicates to form the Oriental Telephone Company, Limited. In 1881 Mr. Lorrain commenced private practice in Westminster as a consulting engineer and patent agent, acting as consulting engineer to a large number of important undertakings. He is a Member of the Institution of Electrical Engineers, a Member of the Institution of Mechanical Engineers, a Fellow of the Royal Physical Society of Edinburgh, a Fellow of the Chartered Institute of Patent Agents, a Member of the Société Française de Physique, a Member of the Society of Chemical Industry, &c.

LUNDBERG, A. P. Born and educated in Sweden, and apprenticed to a scientific instrument maker.

At the end of his apprenticeship, Mr. Lundberg received the silver medal from the Society of Arts and Trades for excellence of workmanship for work submitted and good conduct during apprenticeship. A year afterwards he received a premium from the Swedish Government, which enabled him to visit foreign countries, and during the following three years was employed in various workshops in France, England and Germany. After a visit to Russia, he returned to England in 1862, to visit the International Exhibition held in London, and he has remained employed in England or for English firms ever since. He was the principal maker of Mr. Scheutz's calculating machine, which was sold to the Albany Observatory U.S.A., but a *fac-simile* may be seen at Somerset House. Between 1862 and 1882 he was employed by several important firms in the capacity of workman and foreman. At the commencement of the International Electric Exhibition held at Paris in 1881, he was sent by Messrs. Crompton and Co. as their assistant to the said Exhibition, and on his return he started a small but successful business for manufacturing electric light fittings, switches, holders for incandescent lamps, wall sockets, &c., which has since been considerably extended, and in which he is assisted by his two sons, Messrs. Gus C. and P. A. Lundberg. Mr. Lundberg exhibited at the International Inventions Exhibition, 1885, chiefly electric light switches, lampholders, and an arc lamp of his own invention, and was awarded a bronze medal. One particular switch exhibited there has been well received by electrical engineers and consumers of the electric light, both at home, on the Continent, and elsewhere, and over 100,000 of the original design, or its numerous modifications, have been sold since its introduction in 1883. Other specialities in electrical fittings have also been well received. Mr. Lundberg was awarded a medal for numerous improvements in electric light fittings at the Crystal Palace Electrical Exhibition of 1892. Amongst the apparatus was the "Unique" switch, which has received a large amount of attention from electrical engineers and from the technical press. This switch, for which Mr. Lundberg has taken out patents in the principal countries of Europe and in America, is of the "one direction" type, and has had a large sale, Mr. Lundberg himself having sold over 45,000, and licensees are also working under the same patent in Great Britain, France, Sweden, Austria and Hungary. Mr. Lundberg may take credit for having executed many pieces of good work, and for having devised various improvements and inventions; and as an industrious and ingenious worker he has taken an honourable place.

LUNDBERG, Gus. C., son of Mr. A. P. Lundberg. Born in London, 1867. After obtaining an "Aske" Scholarship, he entered the schools of the Haberdashers' Company in London.

Leaving school in 1882, Mr. Lundberg was apprenticed to his father, and remained with him for six years. He received the certificates of the City and Guilds in the Ordinary and Honours Grade, and a bronze medal for electric Lighting and Transmission of Power. In 1888 he went to the United States, and entered the employ of the Bentley-Knight Electric Railway Company of Alleghany as electrician, and while with them he experienced the diffi-

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culties occurring in the early days of electric railway work. The line erected there was worked on a combination of the overhead and conduit systems, and was one of the pioneer applications of electricity for tramway work in the States. At the end of 1888 Mr. Lundberg was transferred to the New York factory of the Company, and while there had charge of the motor-testing and wiring department. On the combination effected between the Thomson-Houston and Bentley-Knight Companies, the staff of the latter was transferred to Boston, Mass. While in Boston Mr. Lundberg acquired considerable experience in equipping the street car system of the West End Street Railway Company with electric motors. Leaving Boston, Mr. Lundberg was engaged for some time on experimental work on the system of the Baltimore and Ohio Railway Company in Staten Island, N.Y. He returned to England in 1890, and re-entered his father's works as his assistant.

MACDONALD, Colonel and Brigadier-General The Right Hon. John Hay Athole, P.C., Q.C., C.B, LL.D., F.R.SS. (L. & E.), M.I.E.E., Lord Justice-Clerk of Scotland, and Lord President of the Second Division of the Court of Session; son of Matthew Norman Macdonald Hume, Esq., W.S., of Ninewells, by his wife, Grace Hay, daughter of Sir John Hay, of Smithfield and Haystonne, Bart.; was born on the 27th December, 1836.

Educated at the Universities of Basle and Edinburgh (LL.D. Edin., 1884), the Lord Justice-Clerk entered the bar of Scotland as an advocate in 1859, and was made Q.C. in 1880. He held the offices of Sheriff of Ross, Cromarty, and Sutherland, 1874-76; Solicitor-General for Scotland, 1876-80; and Sheriff of Perthshire, 1880-5. Was one of H.M. Commissioners of Northern Lights 1876-80 and 1885-8; member of H.M. Prison Board for Scotland and H.M. Board of Supervision, 1880-85. Was Dean of the Faculty of Advocates 1882-5, and Lord Advocate of Scotland 1885-8; sworn of H.M. Most Honourable Privy Council 1885; one of the Committee of Council on Education in Scotland, 1885-8; Companion of the Bath. 1886; Volunteer decoration, 1892; Chairman of Royal Commission on Boundaries of Glasgow, 1887; Lord Justice-Clerk of Scotland and Lord President of the Second Division, Court of Session, 1888. He is a J.P. and D.L. for the county of the City of Edinburgh, and a Member of H.M. Board of Manufacturers for Scotland. He was Colonel-Commandant of the Queen's Rifle Volunteer Brigade, 1882-1892; Brigadier-General of the Forth Brigade since 1888; F.R.S E., 1886, and Associate (1882) and Member (1886) of the Institution of Electrical Engineers; F.R.S., 1888. Is a Brigadier-General of the Royal Company of Archers (Queen's Body Guard for Scotland). Unsuccessfully contested Edinburgh 1874 and 1880, and Haddington Burghs 1878; and sat as M.P. for Edinburgh and St. Andrews' Universities 1885-8. Married, 1864, Adelaide Jeanette (died 1870), daughter of Major Doran, of Ely House, Wexford, and has issue. Residences: 15, Abercromby-place, Edinburgh; New and Royal Societies Club, Edinburgh; and Constitutional Clubs, London. Inventor of a portable field telegraph for the use of armies in the field (silver medal, International Exhibition, Edinburgh) and a holophote course indicator for the prevention of collisions at sea (silver medal, Edinburgh Exhibition; bronze medals, International Invention Exhibition, and Crystal Palace Electrical Exhibition; diploma of honour, Exhibition of Means and Appliances for Preservation of Life, Alexandra Palace, 1882). He has also received decorations and awards from His Majesty the King of the Belgians and the United States President and Congress.

McGREGOR, Wm., Member of the Institute of Electrical Engineers, Managing Director of the Polytechnic, Bournemouth, &c., and late Chief Superintendent Government of India Telegraphs, Assam.

Mr. McGregor was born in 1838; he is the eldest son of the late William Lewis McGregor, M.D., a senior surgeon of the Bengal Army. He was prepared for the Euphrates Valley or Indian Junction Telegraphs, but on the outbreak of the Indian Mutiny was trained at Gresham House under Sir W. B. O'Shaughnessy, Knt., founder and first Director-General of the department for service in the Indian Telegraphs, which he joined under covenant with the Honourable East India Company in August, 1857, arriving at Calcutta in November, when the Mutiny was at its height. Six months later he was placed in charge of the Presidency office, having previously ranked as second at this very trying period. After holding charge of such important offices as Calcutta, Benares, Agra, Delhi, and Simla, he was promoted to Assistant-Superintendent (one of the original ten) and posted to the Dacca Circle, where he was placed in special charge of the construction of the first land line connecting India with Burmah, and where the attacks of jungle fever nearly proved fatal. Notwithstanding this, he was able to render valuable service during the cyclone of 1864, when the lines for a radius of 80 miles around Calcutta were totally wrecked, and all telegraphic communication entirely cut off. Afterwards he was transferred to the Scinde Division, Kurrachee, where he not only discovered and removed the fault causing unsatisfactory communication on the main line to Bombay on the eve of the opening of the line to Europe, but later on rendered valuable service during the floods of 1866, when many lines were washed away. He was favourably mentioned and noticed in the *Gazette of India*. Serious illness caused by this exposure and previous exposure when doubling the Kurrachee line during the worst season of the year, compelled him to take sick furlough to England in March, 1867. In London he attended the lectures by Prof. Tyndall, at the School of Mines, and before returning to India published his "Questions on Magnetism, Electricity and Practical Telegraphy." He also while on this sick leave took out a provisional patent for a telescopic iron mast

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for telegraph spans across Indian rivers, but from various causes was unable to complete the patent. A very similar support is, however, now in use in India under the title of the A B C D E combination. Having, while at Simla, passed the old Higher or P.H. Standard Examination in Hindustanee, he was asked by the India Office to undertake the examination in London of candidates taking up that language, in 1867-8. On his return to India he was appointed Superintendent of the Indore Division, a post he held for five years; here he successfully introduced the experiment of working combined telegraph and post offices, and the training of soldiers in telegraphy, working several of his offices by them. His exertions both in respect to these experiments and the work of the division were most favourably commended and noticed by the Agent to the Governor-General for Central India. In 1874 he again took furlough to England, devoting his leisure to study and the subject of lightning accidents, and before returning to India published his pamphlet "On the Protection of Life and Property from Lightning," on which the Director-General of Telegraphs in India was requested to inform Mr. McGregor that his attention to this subject was viewed with satisfaction by the Government of India. From the date of his second return to India in 1875 to September, 1884, and subsequent retirement from the Indian Service, Mr. McGregor held administrative charge for a few months of the Arakan Division, and for over nine years of the Assam Division, during which period the telegraph was considerably extended, from Gauhati to Dibrughur and Sudya; from Dhubri, up the north bank of the Brahmaputra River, to the site of a new cable, which was successfully laid while the old one was considerably lengthened after removal of faults. During the Naga Hill disturbances the wire was carried into that country, connecting the stronghold of Kohima with the civilised world. Mr. McGregor was in charge of the arrangements in connection with the field telegraph and post offices during the military operations which resulted in the recapture of the stockade at Kohima, in addition to his own duties, services for which he was favourably mentioned and thanked by the Assam Government and the Director-General of Telegraphs. While in the Indian Telegraph service he suggested, among other ideas, the use of stamps, a simple lightning protector for instrument relays, and, before a proper check and electrical standard were adopted, means for reducing the very great waste of battery material, &c. Since retirement from the Indian Telegraph service Mr. McGregor has been most anxious for employment, and has energetically, so far as means and health permitted, pushed to public notice the subject of lightning protection, and has published another pamphlet, "On the Loss of Life and Property by Lightning at Home and Abroad," as a plea for the formation of a society for the protection of life and property from lightning, of which his old chief, Sir W. O'S Brooke, Kt., consented to become patron. At the British Association Meeting held at Birmingham in 1886 he read a Paper on this important subject, and but for ill health, caused by length of service and extraordinary exposure in some of the worst parts of India, it was his intention to have again brought forward the subject at the Manchester, Bath, and Newcastle-on-Tyne Meetings in 1887, 1888, and 1889. Since removal to Bournemouth Mr. McGregor has been elaborating a seaside Polytechnic scheme for that rising town, with classes, private and popular, for the study of arts, sciences, languages, and industries; the Athenæum Home Club for those engaged in teaching. The Central Public Subscription and Penny Reading Rooms, conducted by him, are making progress, and becoming useful institutions, with special reference both to technical and scientific instruction.

MAIER, Julius, Ph.D. Born in Stuttgart, Germany; educated at the Gymnasium and Polytechnic School of Stuttgart and the Universities of Göttingen and Greifswald.

Mr. Maier came to England in 1866, and was science master in Cheltenham College from 1872 to 1883. He is the author of "Aetherische Oele" (essential oils), published by Neff, of Stuttgart; "Hospitalier's Modern Applications of Electricity," "Arc and Glow Lamps," "The Telephone and its Practical Applications" (in conjunction with Mr. W. H. Preece).

MANCE, Sir Henry Christopher, C.I.E. Born in Exeter, 1840.

Sir Henry Mance was educated at private schools in Bath. In 1858 he entered the service of the Electric and International Telegraph Company, served four years in the London district (partly at the India Office), and in 1863 was appointed to the Persian Gulf Telegraph Expedition, organised for the Secretary of State for India by the late Colonel Patrick Stewart, R.E., with the object of effecting telegraphic communication between England and India. During the manufacture of the cable at the gutta-percha works, Wharf-road, Sir Henry, or, rather, Mr. Mance, as he then was, was placed at the disposal of Messrs. Bright and Clark, the Government engineers, and while serving under the late Mr. C. E. Laws, their chief electrician, acquired the experience qualifying him for the appointment of assistant-superintendent, in which capacity he joined the Mussendum Station, in Arabia, at the entrance of the Persian Gulf, after accompanying Colonel Stewart overland to Bombay, and serving with the expedition during the submersion of the Gwadur-Mussendum section. He was promoted to the grade of superintendent in 1866, and served for some years in that capacity in Mesopotamia, Persia, Arabia, Beloochistan, and India. In 1869 he invented the heliograph, and having designed an efficient form of sun-signalling apparatus, for many years energetically advocated its use in the British Army. The value of the system, which is now adopted in nearly every military service in the world, was fully demonstrated during the Afghan Campaign of 1878-9, and also during the war in Egypt. For his services in connec-

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tion with this invention he was, in 1883, created Companion of the Indian Empire. In 1872, under instructions from the Secretary of State for India, he visited the cable station at Valentia for the purpose of reporting to Government on the system of working. During his service in the Government Persian Gulf Telegraph Department he acted for one year as traffic manager and in 1873 was appointed (at first officiating) engineer and electrician of the cable. On the occasion of his first repairing expedition (July, 1873) the body of an enormous whale was raised to the surface entangled in the fractured cable. While serving as engineer he superintended the erection at Karachi of a factory equipped with the necessary machinery for the manufacture of telegraph cable. His method of taking the internal resistance of batteries, now known as "Mance's method," was communicated by Sir William Thomson to the Royal Society in 1871. He is the author of certain Papers published in the *Proceedings* of the Society of Telegraph-Engineers on "Duplex Telegraphy," "The Durability of Guttapercha and Indiarubber Joints," "The Relative Susceptibility of Indiarubber and Guttapercha to Attacks from the Teredo"; and he was the first to communicate a description of the remarkable light circles phenomenon seen at rare intervals on the surface of the sea in the vicinity of the Persian Gulf, the cause of which has never been satisfactorily explained. On the introduction of the Brown-Allan relay, in connection with the Persian Gulf cable, he designed especially for these instruments an automatic system of double-current translation. The difficulties caused by the unstable character of this sensitive relay were entirely obviated by means of this system, which is still working successfully, while at the same time considerable economy in working has been effected. In 1884 he published in the *Journal* of the Society of Telegraph-Engineers and Electricians his method of eliminating, by means of a simple formula, the effects of polarisation and earth-currents while testing partial earth-faults in cables. By the application of this correction errors in testing are reduced to a minimum. For this Paper he was awarded by the Society the Paris Exhibition Premium for that year. In 1885 he received the honour of knighthood, and was deputed by Government to assist the late Sir John Bateman Champain, Director-in-Chief of the Government Indo-European Telegraph, in organising and fitting out the expedition, consisting of the cable ships "Dacia" and "International," for the purpose of duplicating over 500 knots of the Persian Gulf cables. He is the author of the book giving an official report of this work, after the completion of which he retired from the Government service. Sir Henry was Captain in the Sind Volunteers for some years, and appointed by Government Scientific Referee to the port of Karachi. Sir Henry is a member of the Physical Society and of the Institute of Civil Engineers, a vice-president of the Institution of Electrical Engineers, was president of the Wednesbury Institute for 1890-91, is chairman of the Oxford Electric Light Company, the Bedford Electric Light Company, and a director of the West African Telegraph Company and of the Electric Construction Company.

MARKS, Louis B., B.S., M.M.E., Member Am. I.E.E. Born New York City, January 25, 1869; educated at College, City of New York, and Cornell University.

Began study of electricity in 1882, and entered New York College 1883. Most of his time at college was devoted to the study of chemistry and physics, and he made a specialty of light in experimental work in his private laboratory. He graduated Bachelor of Science at College, City of New York, in 1888, entered senior year at Cornell University the same year, and was graduated in the Electrical Engineering course with M.E. degree in 1889, and with M.M.E. degree in 1890. He represented the Cornell University at Boston in 1890 at the general meeting of the American Institute of Electrical Engineers, and presented a Paper on "Life and Efficiency of Arc-Light Carbons." The results published in this Paper were based on original investigations by the author in the physical laboratory of Cornell University, the investigations having been carried on under the direction of Prof. Nichols. While at Cornell he made a specialty of the arc light, but he also made researches in widely different branches of physics. Mr. Marks devised the "spiral-coil" voltameter, the merits of which have been discussed in a Paper presented before the American Institute of Electrical Engineers by Prof. Harris J. Ryan. He has made experimental researches on converters, especially effects of heating the cores, the results of which have been published in the *Transactions*. He entered the service of the Washington Carbon Company, of Washington, Pa., in 1890, as expert, and continued with them for three years, during which time he devised several new forms of electrodes and took out several patents, among them the American moulded cored carbon patent. In 1893 he became affiliated with the Royal Arc Electric Company, of U.S.A., and is the chief electrician of the Company. He has lately made extensive researches on a new form of arc light, the invention of Mr. Louis E. Howard. He read a Paper on "A New Incandescent Arc Light" before the International Electrical Congress, at Chicago, in August, 1893.

MASCART, Eleuthere Elie Nicolas, was born at Quarouble (Nord), France, on February 20, 1837. He studied at the College of Valenciennes, and graduating there, became tutor at the Lycées of Lille and Douai, at the age of 19. In 1858, in order to complete his studies, he entered the École Normale Supérieure, and, after completing the course, remained until 1864, as préparatour, or assistant professor.

In 1865 M. Mascart was called to the Chair of Physics in the Lycée at Metz, and shortly after to the same Chair at Versailles. In 1868 he took the adjunct professorship of physics at the College of France, beside the celebrated Regnault, and on the retirement of the

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latter he succeeded to the full professorship. During the Franco-Prussian war M. Mascart undertook the sub-directorship of the cartridge and chassepot factory at Bayonne, and at the end of the war was created Chevalier of the Legion of Honour. In 1878 he was appointed Director of the Central Meteorological Bureau of France, a position which he still holds, and in 1884 was elected a member of the French Academy of Sciences. The scientific writings and publications of M. Mascart are quite numerous, and all of eminent value. His first work was published in 1864, and was a memoir entitled "Researches on the Ultra-Violet Solar Spectrum and the Determination of the Wave Lengths of the Luminous and Ultra-Violet Rays." Since then he has given to the world a large number of memoirs, especially on light and electricity. In 1876 M. Mascart published his "Treatise on Static Electricity," in two volumes, and between 1882 and 1886 the well-known work entitled "Lessons in Electricity and Magnetism.' This work, in which M. Joubert collaborated, has been translated into the English and German languages. M. Mascart has lately published a "Treatise on Optics," in three volumes which, like his preceding works, has at once become a standard authority on the subject. M. Mascart is much sought after as a representative in scientific circles. He has been President of the French Physical Society, of the Société Internationale des Electriciens, and of the French Meteorological Society, and he is at present Vice-President of the Consulting Committee on Arts and Manufactures attached to the French Ministry of Commerce. At the Paris Electrical Exhibition and Congress of 1881, M. Mascart was general reporter of the Congress and of the Jury, for which services he was created Officer of the Legion of Honour. In connection with the Paris Exhibition of 1889 M. Mascart was President of the Technical Committee on Electricity, President of the Jury of Class 62 (Electricity), and also President of the International Congress, and he was then created Commander of the Legion of Honour.

MASSEY, W. H. Born Oct. 1, 1848, at La Seyne, near Toulon.

Educated partly in France and Russia, and also at the Grammar School, Leeds, in which town he subsequently served a long apprenticeship with a firm of engineers and millwrights. After being at sea in a Russian steamship, he entered, in 1870, the employ of Messrs. John Penn and Sons, of Greenwich, where he soon took a leading position in outdoor affairs. In 1875 Mr. Massey was engaged by a company of marine engineers in Berlin, and several important contracts in the German Government dockyards were entrusted to him. He returned to England the following year, and after being for some time with Messrs. Hunter and English, of Bow, he was in 1877 appointed outdoor manager for Messrs. John Fowler and Co., the agricultural and mining engineers. During the next four years Mr. Massey's work took him into every part of England and Wales, and he was frequently consulted as to engines and machinery for electric lighting. In October, 1881, he accepted an offer from the Electric Light and Power Generator Company, to be their general manager; but finding himself in disagreement with his directors and the promoters he soon resigned his appointment and started in business on his own account, being retained as consulting engineer to the company. He afterwards acted as advising engineer to the Swan United Company, in getting together the staff of the Edison and Swan Amalgamated Companies; and he has since then established an extensive private consulting practice. Mr. Massey is a member of the Queen's Household, his appointment there being regarded as the first official recognition of electrical engineering. He is a member of the Institution of Electrical Engineers; of the Institution of Civil Engineers; of the Institution of Mechanical Engineers; of the Institute of Marine Engineers; of the Iron and Steel Institute; of the Physical Society; of the South Wales Institute of Engineers; and is a *membre fondateur* of the Société Internationale des Electriciens. He is the author of several Papers on "Compressed Air," and the "Practical Application of Electricity." Mr. Massey served on the Electrical Jury at the Inventions Exhibition in 1885, and also on the Jury for Machinery in General at the Paris Universal Exhibition, 1889, when he was made "Officier de l'Instruction Publique." He was a member of the Council of Advice, and on two juries at the Crystal Palace Electrical Exhibition in 1892; he was on the Committee of Engineering and Architecture for the World's Fair in 1893, and was appointed judge for machinery by the British Commission, but was prevented by illness from going to Chicago.

MAVOR, Alfred E., M.I.E.E., A.M.I.C.E. Born at Glasgow in the year 1865.

Mr. Mavor was educated at the Glasgow Academy, and after spending two years in the drawing office of a civil engineer joined the Edison Company in 1882. Mr. Mavor carried out a large number of installations on board steamships, and devoted much attention to this branch of electrical engineering. With a view to extending his experience he went a voyage round the world in 1883, visiting the Australian Colonies and South America. On his return to England he was appointed electrician to the Chilian Navy, holding a commission as Lieutenant. Mr. Mavor remained on the Pacific Coast for two and a-half years, and developed many naval electrical appliances on board the war ships and torpedo boats of the fleet. On the termination of his engagement with the Chilian Government. Mr. Mavor went north to San Francisco as a guest on board the U.S. frigate "Shenandoah," and continued his travels through the United States and Canada. Returning to England at the end of 1886 he was commissioned to rearrange and extend the installations required for lighting the superstructure of the Forth Bridge during its construction; extensive plant was put down under his supervision, and arrangements made to enable the work to be carried on by night almost as rapidly as by day. On the completion of his work there,

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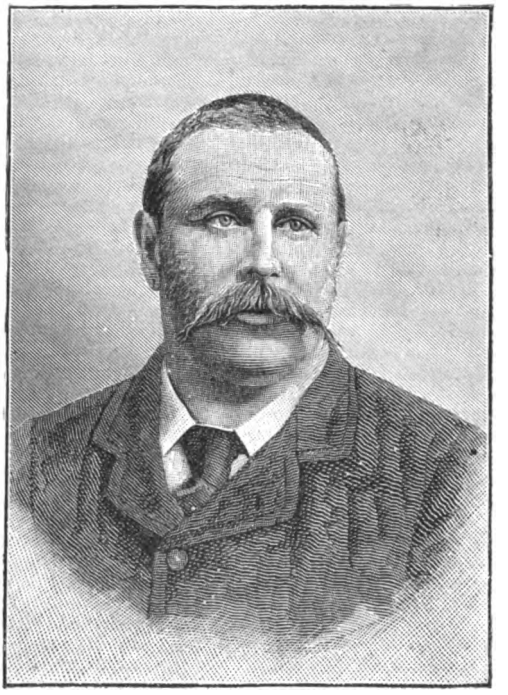

W. H. MASSEY.

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he was appointed electrician to Messrs. Denny Bros. of Dumbarton; and in May of 1890 he joined the Fowler-Waring Cables Company as General Manager, a position which he now holds.

MAXIM, Hiram Stevens. Born at Sangersville, in Maine, February 5, 1840.

Amongst Mr. Maxim's early inventions may be mentioned the following:—Machines for making illuminating gas, automatic boiler feeds, automatic water-raising appliance, automatic fire alarm and extinguisher, &c., &c. Maxim's electrical career may be said to have commenced in 1877, when he made a writing telegraph, which lent itself admirably to transmitting messages in the Chinese language, the letters in which are too numerous for the Morse code. This invention was, however, destined to be superseded by the telephone, then brought out by Prof. Graham Bell. At that time Maxim expressed to Mr. Schuyler, with whom he had made an arrangement for electric lighting experiments, his opinion that the carbon of lamps does not become fused or volatilised, but simply oxidised by the atmosphere, or by some combination of the oxygen in the lamp. To prove that oxygen is the sole destructive agent, he made a lamp from which he expelled the air, introducing gasoline vapour in its place, when he found that the carbon, instead of wearing away, gained in weight and volume, while assuming a grey metallic colour. He then experimented with platinum for producing light, and invented an incandescent lamp with a filament of that metal, at the same time turning his attention to the divisibility, and also the regulating, of electric currents. In 1878 Maxim brought out his carbon incandescent lamp. He afterwards devised several systems of arc lighting which produced an intense light in the focus of parabolic reflectors, the suspended lamps being fed by a single current; and afterwards a regulator of arc lamps. At this stage Maxim had already obtained more than a hundred patents for inventions, many of which related to the details of electric lamps. Having completed his system of arc lighting, he returned to the carbon incandescent lamp, which he had abandoned after having secured it by patent. He wished to employ phosphoric anhydride or anhydrous phosphoric acid for neutralising the humidity in incandescent lamps, but was unable to procure it in New York, so studied its composition and preparation. In a single day he had constructed the apparatus, and by the evening had obtained two litres of this substance (P_2O_5) in a perfectly pure state. In 1880, on a meeting of watchmakers held in New York coming to the conclusion that there was no remedy for the magnetisation of watches, Mr. Maxim asked to be entrusted with a couple, which he completely demagnetised, having devised a machine for that purpose. To keep down the floods of Mexico, and learning that coal was expensive, he proposed to utilise the waterfalls for driving his dynamos, transmitting the force by electric currents. The jury of the Philadelphia Electrical Exhibition awarded a gold medal to the United States Electric Lighting Company, founded in 1877 by Messrs. Schuyler, Maxim, and Williamson, to whom Maxim made over his electric lighting patents. In 1880, on the capital of this company being considerably increased, works were established which are said to be the most complete in New York, besides other branch works in various parts of America. In 1881, Mr. Maxim received the decoration of the Légion d'Honneur from the French Government for his electrical exhibit at the Exposition in Paris. The most noteworthy invention of Mr. Maxim is his system of automatic firearms, in which the force of the recoil is utilised for performing all the functions necessary for loading and firing the arm. The advent of this new system may be said to mark the beginning of a completely new epoch in the manufacture of military firearms. All the great gunmakers in the world, with only one exception, have already expressed their desire to adopt this system. It is said that Mr. Maxim's patents bring in a yearly revenue of a million dollars, or £200,000.

MAY, Dr. Oscar, was born in 1855 at Liestal, in the canton of Baselland, Switzerland.

After studying at the Frankfort Real Gymnasium and at the Aachen Polytechnicum, he took the degree of Doctor in Natural Sciences at the Freiburg University. Dr. May is one of the founders of the Elektrotechnische Lehr- und Untersuchungs-Anstalt of Frankfort-on-the-Main, and is instructor in electric lighting in that institution. At the Frankfort Exhibition in 1891 he was a member of the Presiding Committee, and one of the secretaries of the Scientific Commission. He is the author of the "Lehrbuch der Kontaktelektricität" (1887), the "Anweisung für den elektrischen Lichtbetrieb" (1887), the "Lehrbuch der Elektrodynamik" (1888), the "Lehrbuch der Elektromagnetismus," Part I. (1888), "Tafel zur Berechnung von elektrischen Leitungen" (1889), "Tafel zur Berechnung von Riemenbreiten" (1890), and "Erläuterungen zu den Vorsichts-Bedingungen für elektrische Licht- und Kraft-Anlagen des Verbande Deutscher Privat-Feuerversicherungs-Gesellschaften" (1893). English and French editions of several of these works have also been published.

MENDENHALL, Thomas Corwin, Ph.D., LL.D. Member of the National Academy of Sciences, &c., &c. Was born on October 4th, 1841, near Hanoverton, Ohio, U.S.A.

He is of Quaker stock, tracing his descent from Benjamin Mendenhall, who emigrated from Wiltshire, England, with William Penn, and settled in Delaware County, Pennsylvania, U.S.A. The earlier form of the family name was Mildenhall, and it is to be found in early English records of the 14th and 15th centuries. His father was one of the pioneers in the settlement of the Mississippi Valley, and as a consequence his early youth was spent under conditions which afforded few opportunities for scholastic training. A fondness for study, and especially for mathematical and physical books

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was developed at an early age and was a sufficient incentive to induce him to make the best possible use of such facilities for obtaining an education as were available. These were few, however, and he was mostly dependent upon his own efforts. At an early age he became a teacher. On the opening of the Ohio State University in 1873, he was elected to the chair of Physics and Mechanics; and one of the first working physical laboratories for students established in the United States was that organised by him at this time. In 1878 he went to Japan as Professor of Physics in the Imperial University, when he had for colleagues Professors J. A. Ewing, John Milne, and Thomas Gray, and for a brief time Professors Ayrton and Perry, who had been employed in the Engineering College. In the latter part of 1881 he returned to America and resumed his professorship of physics at the Ohio State University. In 1884 he went into Government service at Washington as Professor of Electricity in the United States Signal Service. In 1886 he resigned to accept the presidency of the Rose Polytechnic Institute at Terre Haute, Indiana. After serving in this capacity for three years he was appointed, in the summer of 1889, as Superintendent of the United States Coast and Geodetic Survey, with headquarters at Washington, which position he still occupies (1893). He has received the degree of Ph.D. from the Ohio State University and that of LL.D. from the University of Michigan. He is a member of the National Academy of Sciences, of the American Academy of Arts and Sciences; is past president of the American Association for the Advancement of Science; member of the American Institute of Mining Engineers, and of many other societies. Dr. Mendenhall has been called upon to perform a number of important duties of a semi-diplomatic character, for which his training and experience had fitted him. Among these may be mentioned his service as one of the two United States Commissioners in the Behring Sea Investigation, also his appointment as Commissioner on the part of the United States to mark the boundary line between Maine and New Brunswick and as Commissioner to conduct the joint survey of the boundary line between Alaska and the British Possessions. He was also one of the five delegates representing the United States in the International Electrical Congress held in Chicago, in 1893. Besides being superintendent of the Coast and Geodetic survey he is, by appointment of the President, a member of the Lighthouse Board, and is superintendent of the office of Standard Weights and Measures. He has published numerous contributions to science, in the transactions of scientific societies and in the leading scientific journals. Many of these have related to electricity, and in 1886 he published a historical *résumé* in one volume, entitled "A Century of Electricity," of which an English edition was also issued. During his connection with the United States Signal Service, and for some time after, he carried on systematic experiments relating to atmospheric electricity, the results of which were published in an extensive memoir by the National Academy of Sciences in 1892. He is actively interested in gravity research, having made determinations by the use of the pendulum in Japan and in Alaska and the Pribilof Islands, by improved methods and instruments, largely of his own design.

MILLER, Oscar von. Born in Munich in 1855. Educated at the Polytechnikum.

He commenced his professional career as engineer during the construction of railways, bridges, and waterworks. In 1880 he passed the examination for State Engineer, and was transferred to the Government of Upper Bavaria, and in the following year he was sent to the Paris Electrical Exhibition to report on the development of electricity. On his return to Munich, von Miller superintended the electrical experiments in the Glass Palace, at the first Electrical Exhibition in Germany. It was under his supervision that the historic experiment of transmitting power from Miesbach to Munich was carried out by means of a telegraph wire. In 1883 he was commissioned by his Government to report on the best means of utilising the water power of Bavaria for electrical purposes, and in quest of information he travelled through Italy, France, Holland, Belgium, England and America. Later in the same year he became manager of the newly-founded Edison Company in Berlin (now the Allgemeine Elektrizitätsgesellschaft), and in conjunction with his colleague Herr Rathenau constructed the first and largest central station in Germany. In 1885 he also undertook the management of the Berliner Elektrizitätswerke, and held both positions until 1890, when he returned to Munich. There he founded an office for planning and constructing electrical central stations for the transmission of power, and built those at Cassel (where he utilised a distant waterpower for the production of electricity), Lauffen-Heilbronn (the machines at which place were used for the celebrated Lauffen-Frankfort long-distance power transmission), and Schöngeising-Fürstenfeld Bruck. He has been engaged by many local authorities in planning central stations, as for Frankfort-on-the-Main, Buzen-Meran, Stuttgart, Strasburg, Munich, Wiesbaden, Heidelberg, Nuremberg, Hermanstadt in Siebenbürgen, Kristianstad in Sweden, &c. In 1891 Oscar von Miller was invited to undertake the technical conductorship of the Frankfort International Electrical Exhibition, where he endeavoured to give a stimulus to the electrical transmission of power and to settle the then burning question of alternate currents *versus* direct currents, and his efforts have been acknowledged on several occasions in Bavaria, Prussia and Italy.

MORDEY, William M., M.I.E.E., was born in March, 1856.

When fourteen years of age Mr. Mordey entered the Postal Telegraph Service. After being employed for a short time in London he was removed to Bradford, Yorkshire. Having devoted his leisure to the study of branches of physics related to telegraphy, with a view to obtaining some scientific knowledge of

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that subject, he was asked to conduct classes formed by his fellow *employés* for the study of electricity and magnetism and telegraphy. These classes, which were in connection respectively with the Science and Art Department and the City and Guilds Technological Institute, were very successful. In telegraphy he had to rely entirely on his own resources, as no tuition was obtainable. Sitting for examination with his own class in 1881 he obtained the second prize and medal of the City and Guilds Institute in the "Advanced Stage" of this subject. At the end of the same year he left the telegraph service, and obtained employment as an electrician with the Anglo-American Brush Electric Light Corporation, now the Brush Electrical Engineering Company, and was at once offered the post of superintendent of the testing department in the works of this corporation in London. He has continued in this service till the present time, being now the Company's chief electrician. Among the earlier advances in everything connected with what has been called "heavy electrical engineering," not the least important was the success of the Brush Corporation's "Victoria" dynamo, a machine which was the result of Mr. Mordey's discovery and investigation of some interesting abnormal features in a less perfect form of generator. In 1883 he described, before the Society of Telegraph-Engineers, some experiments showing that the resistance of masses of finely-divided metals really follows the same law as carbon—viz., that such resistance diminishes with the rise of temperature, an action that had previously been supposed to form a dividing line between carbon and metals. For a Paper by him on "Some Prejudicial Actions in Dynamo Machines," read in 1884, he received the honourable mention of the Council of the above-mentioned society. In the same year he described, before the Institution of Civil Engineers, the methods and constructions that are best adapted for working compound dynamos of similar, as well as unlike, size, powers, or speed, in parallel circuit. To the *Philosophical Magazine* for January, 1886, he contributed a Paper on "The Dynamo as a Generator and as a Motor: Some Analogies and Contrasts," in which some experiments and observations, made by himself and Mr. C. Watson, were described that threw something more than doubt upon many of the views that had generally been held with regard to electric motors. The conclusions arrived at in this article have passed into general practice, although at the time they were diametrically opposed to the teaching of well-known authorities on the subject. At the British Association Meeting of 1886 he read a Paper and showed some experiments on "An Electric-Motor Phenomenon," illustrating very forcibly some effects of self-induction; and in the same year, before the South Wales Institute of Engineers, he read a Paper dealing with the subject of the possibility of explosions in fiery mines with incandescence electric lamps. In 1887 he was engaged at the Victoria Works of the Brush Company on his "Alternator," an alternating-current dynamo of a new type, which, together with his transformer and other apparatus, have been successfully introduced by the Company under the title of the "Mordey-Victoria Alternate-Current System." This system is now being used for general lighting in about sixty towns abroad and at home—amongst other important places, for the lighting of the Central and Western districts of the City of London. Mr. Mordey was in 1888 elected an Associate Member of Council, and from 1890 to 1893 he was a Member of Council of the Institution of Electrical Engineers, before which Institution in 1889 he read an important Paper on "Alternate-Current Working," dealing with many branches of the subject, and especially with the principles underlying the best construction of alternators for the purpose of parallel working and for synchronising motors. For this Paper he received the "Institution Premium" of the year. In 1893 he contributed two Papers on branches of the same subject to the same Institution. In 1891 he visited the United States, mainly to examine the systems of electric traction in use in that country. He is a Member of the Physical Society and of the American Institute of Electrical Engineers. He was on the Electricity Committee of the Royal Commission for the Chicago Exhibition of 1893, and on the Honorary Council of Advice of the Crystal Palace Electrical Exhibition. He is an occasional contributor to the columns of *The Electrician* and other scientific journals.

MOULTON, John Fletcher, Q.C., M.A. (Lond. and Cantab.), F.R.S. Born at Madeley, November 18, 1844.

Mr. Moulton is the son of the Rev. James Egan Moulton. He received his education first at the New Kingswood School, near Bath, where he gave the promise of his later achievements by securing the first place (Senior All-England) in the Oxford examination. From the Kingswood School he proceeded to St. John's College, Cambridge, and here passed through a very distinguished academic career. His predilection was for mathematics, and his success in this department procured for him a series of scholarships and prizes, including the University Scholarship and Gold Medal of the London University, and culminating in the First Smith's Prize and Senior Wranglership. In this last examination Mr. Moulton's pre-eminence was so pronounced that his score of marks so far exceeded those of the Second Wrangler that the excess above what would have been necessary to secure the first position would alone have sufficed to give him high rank in the Honours' List. Upon leaving college Mr. Moulton at first gave his attention to tutorial functions, for which his remarkable college career seemed to designate him. Eventually, however, the attractions of a larger sphere prevailed, and in 1873 he resigned his professorship at Cambridge and migrated to London, where, in the course of the following year, he received his call to the Bar. In the course of his legal career Mr. Moulton has been concerned in a large number of causes in which scientific and technical questions have arisen. In particular, he

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has had a large experience of actions arising upon patents for the various applications of electricity, which is a subject that he has largely made his own. In the years 1879 and 1880 he wrote, in collaboration with the late Dr. William Spottiswoode, at that time President of the Royal Society, two elaborate monographs on the "Electrical Discharge in Vacuum Tubes," or, to give the Papers their authentic title, on the "Sensitive State of Electrical Discharges through Rarefied Gases." These Papers, dealing as they did in an exhaustive manner with the beautiful but little understood phenomena of the manifestations of electricity in very highly attenuated gases, attracted much attention at the time of their publication, and Mr. Moulton was shortly afterwards elected to the Fellowship of the Royal Society. In the following year, 1881, Mr. Moulton assisted at the Congress of Electricians which was held at Paris in connection with the Electrical Exhibition of that year. The Congress, as is well known, addressed itself to the discussion of several questions of capital importance, and, among other things, it succeeded in fixing an international unit of electrical resistance. In these deliberations Mr. Moulton took an active part, and for his services on this occasion to the cause of science he received from the Government of the Republic the decoration of the Legion of Honour. Mr. Moulton has sat in Parliament, having represented Clapham in the Parliament of 1885-86.

MOUNTAIN, William Charles.

Completed his education in 1876 at Sutton Court, Chiswick, London, and was then apprenticed to his father's firm, Messrs. May and Mountain, general engineers and ironfounders, Suffolk Works, Birmingham. After serving about three years of his apprenticeship, Mr. May died, and Mr. Mountain then had to assist his father in the management of the business. In 1880 the firm of May and Mountain was dissolved, and re-established under the style of Mountain and Sons, and until 1883 Mr. W. C. Mountain acted as manager of the business under his father. In this year he was offered the position of engineer to the Gülcher Electric Light Company, which he accepted, and after being with the Company a short time, was appointed General Manager, and had a seat on the Board of Directors. He remained with the Gülcher Company for five years, during which time the business of the Company largely developed, and many improvements in the design of the dynamos and electrical machinery were introduced. At the end of 1888, he resigned his position as manager of the Gülcher Company, and joined Mr. Ernest Scott, of the firm of Ernest Scott and Co., Close Works, Newcastle-on-Tyne, and in August of that year the firm commenced the electrical branch of their business, which is under the control of Mr. Mountain, who introduced their now well-known Tyne dynamo, arc lamp, and transformer; and so successful has this branch of their business been that the firm turned out upwards of 400 dynamos, besides a large number of arc lamps, in less than three years. In November, 1890, the firm was transformed into a limited company under the style of Ernest Scott and Mountain, Limited, who are now carrying on the old business of Ernest Scott and Co. The works have been more than trebled in size; and the firm are now manufacturing combined engines and dynamos.

MUNRO, John. Entered telegraph work in connection with the Great Western Company.

Mr. Munro is the author of "Electricity and its Uses," "Pioneers of Electricity," "Heroes of the Telegraph," "Romance of Electricity," "The Wire and the Wave: a Tale of the Submarine Telegraph," &c.; and he is joint author of Munro and Jamieson's "Pocket-book of Electrical Rules and Tables."

MUNRO, John M. M., M.I.E.E.

After serving an apprenticeship at mechanical engineering, and after a course of scientific study under private teachers and at the Andersonian College, Glasgow, and other technical schools, Mr. Munro joined the firm of Anderson and Munro, of Glasgow (established by his father in 1840). The electrical department of the business was at that time of minor importance, but when the first rumour of the telephone came over from America the firm began to make and erect these instruments, and in March, 1880, issued circulars relative to the establishment of telephonic exchanges in Glasgow. In 1878 Mr. Munro produced and described in various home and foreign scientific journals a form of glow-lamp in which thin pencils of carbon were coated with infusible earths—the idea being that they could be constructed so cheaply that their short life was of no moment. These lamps were worked on a series transformer system, as described in the *English Mechanic*, January 3, 1879. In September, 1881, Anderson and Munro's workshops were lit throughout with Swan lamps, superseding arc lighting by the old A Gramme machines, and within a few months afterwards the firm were engaged in fitting these lamps into factories, &c., throughout Scotland. Thus early and energetically in the field, Anderson and Munro have all along maintained a leading position as electrical engineers, and have designed and erected a large number of electric light installations at home and abroad. They were the engineers and constructors of the very successful Carstairs Electric Railway, and are associated with Sir William Thomson and Dr. Bottomley as electrical advisers to the Kelvinside Electricity Company, Limited. They are also engineers to the Norway Power Transmission Syndicate, and other companies and public bodies. Mr. Munro is patentee of a number of inventions, one of the best known of which is a fire-alarm system, which has been very successful in Glasgow and neighbouring burghs. He also holds important patents relative to electric railways and tramways, and to distribution from supply stations. Mr. Munro has for many years made a special study of town lighting. The

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Munro Electrical Manufacturing Company, Limited, was formed as an independent concern, and now possesses a well-equipped factory to make for the trade these various inventions and electric material generally, Anderson and Munro giving their whole attention to electrical engineering and contracting. Mr. Munro is the author of a little manual on the management of electrical accumulators, and numerous magazine articles, and also a book, "Spiritual Dynamics," dealing with some of the burning questions which lie on the borderland between science and religion.

NEALE, John, M.I.E.E. Born in London in 1833; educated at Trinity School, Bow, under the Rev. H. Barnacle.

Mr. Neale joined the services of the Electric and International Telegraph Company in 1851, at the Strand Office; at Stafford, 1852; at Manchester, 1853; and Birmingham, 1854. In 1859 he was appointed inspector in charge of the North Staffordshire and London and North-Western lines in the midland counties. In 1870, on the transfer of the telegraphs to the Government, he was appointed telegraph superintendent and engineer to the North Staffordshire Railway Company, which position he now holds. In 1855 Mr. Neale proposed and submitted to the Electric and International Telegraph Company, a system of using vertical instead of horizontal dots and dashes, in order that the working of the ordinary single needle instruments could be recorded on the Morse printers, and the two systems assimilated. The suggestion was not adopted. In 1873 he patented the acoustic S.N. dial, which is now used by the Post Office and railways; and a single wire block instrument which is in use on the North Staffordshire Railway; also a recording block instrument for permissive block use, showing the number of trains actually in the section; and a rail brake, so that trains can announce their approach at level crossings automatically. Mr. Neale also acts as honorary secretary to the Railway Telegraph Superintendents and Engineers at their half-yearly meetings.

NICHOLS, Edward Leamington, M.A., Ph.D. (Goettingen). Born in 1854. Educated at Cornell University, Ithaca, New York, the Universities of Leipzig, Berlin, and Goettingen, and at the Johns Hopkins University, Baltimore.

Mr. Nichols graduated with the degree of Bachelor of Science at Cornell University in 1875. A taste for the study of physics, acquired while an undergraduate of that institution, led him to Germany, where he came under the instruction of Prof. Wiedemann, father and son, in Leipzig (1875-76), and Von Helmholtz in Berlin (1876-78). The two years which he spent in the Physical Laboratory of the University of Berlin were devoted chiefly to research, at first as a co-worker with the late Prof. J. J. Mackenzie, of Halifax, in an investigation on the influence of absorbed gases on the volume of liquids (*Annalen der Physik und Chemie*, N.F. 3, p. 134), subsequently on the radiation from glowing platinum. The latter work formed the subject of a thesis, presented upon receiving the degree of Ph.D., in Goettingen, in 1879. Early in that year Mr. Nichols returned to America. He continued his study of physics in the laboratory of Prof. H. A. Rowland, of the Johns Hopkins University, of which institution he had been elected Fellow. In 1880 he joined the forces of Mr. Edison, whose system of incandescent lighting was undergoing the final tests, at Menlo Park, New Jersey, preparatory to its practical introduction into New York. In 1881 Mr. Nichols began his career as a teacher, as Professor of Physics and Chemistry in a small Kentucky college (Central University). In 1883 he was appointed to the Professorship in Physics and Astronomy at the University of Kansas, where he organised courses in electrical engineering, and was instrumental in securing from the State Legislature the first appropriations of money for the purposes of instruction in that subject. In 1887 he was made Professor of Physics in Cornell University, which position he still holds. Mr. Nichols is the author of more than fifty Papers on experimental physics, which have appeared in the leading scientific and technical journals, and in the *Transactions* of various societies. He is a Fellow of the American Association for the Advancement of Science, Past-President of the Kansas Academy of Science, and a member of the American Institute of Electrical Engineers.

OBACH, Eugene, Ph.D., F.I.C., F.C.S., M.I.E.E., &c. Born April 26, 1852, in Stuttgart, South Germany.

Dr. Obach studied mathematics and natural sciences for five years at the Polytechnic School of Stuttgart, under Profs. Gugler, Baur, Zech, Fehling, and Victor Meyer. Acted temporarily as lecturer on chemistry at the Veterinary School of the same town. Completed his studies at the University of Leipzig, under Profs. Kolbe, Wiedemann, Zöllner, Fechner, and C. Neumann, and graduated there as Ph.D. in 1875. He entered the firm of Siemens and Halske of Berlin as assistant to Dr. Werner Siemens in the spring of the same year. Dr. Obach came to England towards the end of 1876, and joined Messrs. Siemens Brothers' staff at Woolwich as chief of the experimental department. Acted as electrician at Ballingskellig Bay, Ireland, during the completion of the Direct United States Cable, and was on board the ss. "Faraday" during the laying of the deep-sea portion of the second French Atlantic Cable. He published his first Paper in 1875, on the action of the galvanic current on amalgams and alloys, and on the nature of amalgamation currents. This subject has recently been prominently brought before the public by the Electrolysis Committee of the British Association, Prof. Roberts Austen's and Dr. Gladstone's experiments entirely confirming Dr. Obach's early results. Dr. Obach is, perhaps, best known by his movable coil tangent galvanometer, which is equally suitable as an ampere- and a volt-meter. The theory of this instrument was first given in *Nature*, in 1878, and a few

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years later a Paper was read before the Physical Society, describing several important alterations of the original form. Dr. Obach's complete tables for readily finding the ratio of the two sections of the slide wire of a Wheatstone bridge are also much used, particularly in Continental laboratories. Other publications deal with the following subjects:—A battery for constant currents of long duration, a lecture apparatus for the demonstration of electric resistance in metallic wires, an electric pressure regulator, a commutator for liquid and gaseous currents, the diffusion of carbonic acid gas through caoutchouc, the action of manganese peroxide in batteries, a direct relationship between specific inductive capacity and latent heat of vaporisation, the action of phosphorescent light on selenium, the detection of free sulphur and selenium in carbon disulphide and their approximate quantitative determination, and the behaviour of carbon disulphide towards potassium permanganate. In the last-named publication a method for the complete purification of commercial carbon disulphide is given, which may also be of interest to electricians.

In February, 1884, Dr. Obach delivered a lecture on the late Sir William Siemens as an inventor and discoverer, at the German Athenæum, London. This lecture, which was illustrated with diagrams and some of the original pieces of apparatus of the inventor, was afterwards published, and very favourably reviewed by the press.

OFFOR, George. Born in London in 1827.

In 1878 Mr. Offor turned his attention to electric lighting, having in that year undertaken the English agency for the sale of Schückert's dynamo machines; and in the following year became an agent for the Anglo-American Electric Light Company, Limited, which subsequently developed into the present "Brush" Company. Among the installations undertaken by Mr. Offor was the lighting of the Castle Museum, at Nottingham; the Hall-by-the-Sea, at Margate, &c.; and through his agency the concession from the Brush Corporation to the Great Western "Brush" Electric Light and Power Company, Limited, was negotiated during the autumn of 1881 and spring of 1882; this being among the first of numerous subsidiary "Brush" companies since formed. Upon the incorporation of the South-Eastern and Provincial "Brush" Companies, in May, 1882, Mr. Offor was appointed their general manager; and in March, 1883, when the Consolidated Electric Company was formed, for the purpose of manufacturing the storage batteries and other apparatus of the B.T.K. system, Mr. Offor undertook the management of that company, also the house-to-house lighting of Colchester, on the storage system of distribution now so successfully employed by the Chelsea Electricity Supply Company, Limited. The arc lighting of the Great Eastern Railway Company's packet station at Parkeston near Harwich, and the extensive installation for Alfred Rothschild, Esq., at Halton House, were important works of Mr. Offor's company; besides numerous installations of a smaller character. Mr. Offor was one of Lord Thurlow's Committee for obtaining an amendment of the Electric Lighting Act, 1882. He is managing Director of the Crystal Palace District Electric Supply Company, which is working the Provisional Order for the supply of electricity to the Crystal Palace and district. A generating station has been erected at Springfield, Upper Sydenham, with plant for 30,000 lamps, and the Company supplied about 400 horse-power of electrical energy for the Exhibition at the Crystal Palace in 1892. Mr. Offor was for a time general manager and secretary of the Oxford Electric Company, Limited. The system adopted by both companies is that of a continuous current at a moderate high pressure, converted at subsidiary stations into low pressure by continuous-current motor-dynamos and storage batteries, with automatic apparatus for regulating the pressure throughout a network of mains.

OSTWALD, William Frederick. Born at Riga, Livland, September 2, 1853.

After being educated at the Riga Real-Gymnasium, he went, in 1872, to the Dorpat University for his scientific studies, where he remained three years. From 1875-1878 he was an assistant at the physical and chemical laboratory of this University. In 1878 he became instructor at the above University, besides teaching physics, chemistry, and mathematics at the "Realschule" in Dorpat. He accepted the professorship for chemistry at the Baltic Polytechnicum (high school for technical science) in Riga, where he worked successfully for six years, and was appointed professor for chemistry and principal of the Physical Chemical Laboratory at Leipzig in 1887. Prof. Ostwald's scientific researches relate chiefly to the problems of chemical affinity. He instituted thorough researches on the relations existing in electrolytical solutions between capacity of chemical reaction and the corresponding electric conductivity, first mentioned by Arrhenius. On account of the various questions raised by Prof. Arrhenius's theory of electrolytic dissociation he brought out several experiments and observations favourable to this theory. Moreover, Prof. Ostwald based the first method on the experiments of von Helmholtz to measure the true differences of potential between metals and electrolytes. In 1887 he published his "Lehrbuch der Allgemeinen Chemie," in two volumes, and in 1889 a treatise on general chemistry, which has been translated into English. Since 1887 he has published, with Mr. Van't Hoff, the *Zeitschrift für Physikalische Chemie*, which Paper contains the fundamental treatise on the modern views of the electrical theory of chemical affinity. Prof. Ostwald is a member of the Saxonian Society of Science at Leipsig, and a corresponding member of the Bataafsch Genootschap Rotterdam, besides an honorary member of the Genootschap ter Bevordering der Natur-, Genees-, en Heelkund (the Amsterdam society for the progress of natural science, medicine, and chirurgery).

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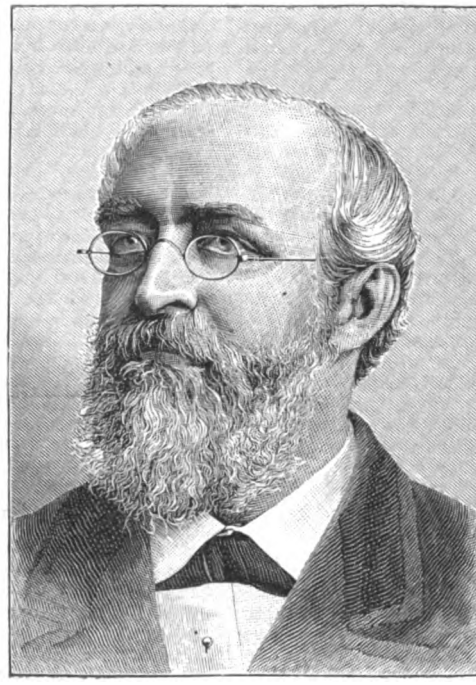

GEORGE OFFOR.

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PACINOTTI, Antonio. Born at Pisa in 1841. Signor Pacinotti's researches have extended in several directions. He has studied the behaviour of thermo-electric currents between metals and liquids; he has made some observations on photo-chemical currents, also those produced by the friction of metals which were united in pairs, and then rubbed on cakes of resin or pitch. The streaks where the metals had rubbed were found, by strewing them with Lichtenberg's powders, to be positively and negatively electrified. He is, however, best known for his work on magneto-electric machines. In 1860 he constructed a machine with a "transversal magnet"—in other words, a toothed-ring closed-circuit armature. This machine he described in *Nuovo Cimento*, in 1865, as a motor, observing also that it could be used as a generator of currents. In 1878 he devised a disc armature, identical in design with that used in Hookham's meter, and closely resembling that used in the modern disc dynamos of Desroziers and of Fritsche. His appearance at the Electrical Congress at Paris in 1881 was hailed with great enthusiasm.

PAGE, Samuel Flood. Born in the Isle of Man in 1833. Educated at Christ Hospital and at Rossall College, Lancashire.

A cadet of 1854, he was gazetted ensign in the 2nd Madras European Light Infantry in 1855, Captain and Adjutant Queen's Own Edinburgh Rifle Brigade, 1860, transferred as Captain and Adjutant to the London Scottish R.V. in 1861. Was the first executive officer of the National Rifle Association; organised the shooting arrangements at Wimbledon and held the responsible charge thereof from 1861 to 1865, and was elected to a seat on the council. He originated examinations for volunteer officers, which were afterwards adopted by the War Office. He was the first to organise special lectures, &c., for volunteer officers at the Royal United Service Institution, and was the first adjutant of volunteers who lectured on military subjects to the officers, non-commissioned officers and men of his corps. In 1873, on his election as Secretary of the Crystal Palace, he retired from the service with the rank of major. In 1877 he was appointed manager of the Crystal Palace, and in 1881-82, acting on the suggestion of Mr. Applegarth, C.E., he organised and carried to a most successful issue the first Electrical Exhibition held in the United Kingdom. He was a member of the Executive Committee of the Fisheries Exhibition for which he drafted the rules and regulations, which were followed in the succeeding South Kensington exhibitions. He was a Commissioner for New South Wales at the Fisheries Exhibition. In 1882 on being appointed general manager of Edison's Indian and Colonial Electric Company, he resigned the managership of the Crystal Palace, the shareholders, on the recommendation of the Directors, giving him a grant of a handsome sum of money. He then went to Australia, and introduced incandescent electric lighting into Victoria, New South Wales, Queensland and New Zealand; the Parliament Houses of those Colonies and of the Cape of Good Hope, and many other public and private buildings were lighted by Edison's Indian and Colonial Company and their agents. Shortly after his return from Australia he was appointed Chairman of the Company in succession to the Marquis of Tweeddale. On the foundation, in 1883, of the Edison and Swan United Electric Company he was offered and accepted the office of Secretary and Manager, and in 1885 the post of Secretary of the Swan United Electric Company was added to his duties; he retained both these offices until 1892. He took an active share in the patent litigation in England and on the Continent, and in the negotiations which resulted in the formation of the Compagnie Générale des Lampes in Paris; and in the fulfilment of the duties of his offices he visited more or less frequently France, Germany, Italy, Austria, Russia, Belgium, Switzerland and Holland. Major Flood Page is now a Director of the Swan Company, of the "Compagnie Générale," of the Manchester Edison-Swan, and is Deputy Chairman of the Edison and Swan Company. He is a member of the Royal Institution, of the Institution of Electrical Engineers, Fellow of the Royal Colonial Institution, and of the Society of Arts.

PARKER, Thomas, F.R.S.E., M.I.C.E., M.I.E.E., M.I.M.E. Born on December 22, 1843, at Ironbridge.

His father, and generations of the family previously, had been employed by the Coalbrookdale Company in their foundry, and at 9½ years of age he had to share the same fate, his schooling up to this age having only been such as was obtained in the school at Coalbrookdale, provided by the Company for the workmen's children. It may be remarked that, at this early age, he had climbed nearly through the arithmetic (decimal fractions and mensuration), records of this having been left in his school books. Mr. Parker in his early life manifested great aptitude for mechanics, and great perseverance, having, as early as 14 years of age, built a model steam-engine, and a violin at 16. Good opportunities existed at Coalbrookdale for after-study in the evening, as the Company provided at this time a library for their workmen, and lectures of the highest class, at which he was a careful attendant. At 19 years, by which time he had signalised himself in his business, he left, and took up his abode in Birmingham. Opportunities of evening study here became greater, and he availed himself of the use of the Midland Institute and other educational means, continuing to signalise himself in his business. In 1867, at the age of 23, his abode became Manchester, where the Free Library and the science lectures at the Hulme Town Hall were his source of education. He again returned to Coalbrookdale, becoming foreman over a portion of the foundry, and about 1876 he obtained promotion to the charge of the chemical department and the electro-depositing of the Company, at this time building his first dynamo, which did the depositing. About 1877 he obtained a

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patent for a steam pump, which was taken up and manufactured by the Coalbrookdale Company. For this he received a medal at the Inventions Exhibition. It is manufactured still by the Coalbrookdale Company. In 1880 Mr. Parker obtained a first medal at the Smoke Abatements Exhibition in London for a design of grate manufactured by the Coalbrookdale Company, called the "Kyrle" grate. Previous to this he had been promoted to the management of the engineering portion of the foundry, and in 1882 he showed Siemens and Edison's incandescent lamps at a lecture table by the aid of secondary batteries he made. He at this time discovered the action of nitric acid as facilitating the formation of secondary batteries. He took out a patent in conjunction with Mr. Elwell in 1882 (No. 3710, 4th August) in which the action of nitric acid was claimed. This patent was divided by the Solicitor-General between M. Gaston Planté and Mr. Parker so far as secondary batteries were concerned. This patent also covered several of the most important forms of alternating-current dynamos built to-day. In October, 1882, he joined Mr. Paul Bedford Elwell and started the partnership of Elwell-Parker in Wolverhampton. This he developed into a Company (Elwell-Parker, Limited) in 1884. In the same year he designed and put to work the electrical machinery of the Blackpool Tramways, remaining to the present time consulting engineer. Since 1884 Mr. Parker has made a number of inventions, both by himself and in conjunction with others, having also made the manufacture of phosphorus by electricity a success. In 1889, Elwell-Parker, Limited, was taken over with other concerns and formed into the Electric Construction Corporation, Limited, of which he is the engineer and manager. In 1890 the Wolverhampton works of the Electric Construction Corporation, Limited, in Commercial-road, being found to be totally inadequate for the work in hand and prospective, Mr. Parker received instructions to lay out elaborate works at Bushbury, just outside Wolverhampton, and under his superintendence these have been fitted with a most complete plant for the production of heavy electrical machinery. Mr. Parker has recently superintended the carrying out of several very large installations in connection with electric traction, including the Liverpool Overhead Railway and the overhead system of electric traction in South Staffordshire. Mr. Parker was made a Member of the Institution of Electrical Engineers in 1885, a Member of the Institution of Civil Engineers on December 3, 1889, a Member of the Institution of Mechanical Engineers in 1891, and a Member of the Royal Society of Edinburgh in 1892. Last year he was made a Justice of the Peace for Wolverhampton.

PARSONS, The Hon. Charles Algernon.
Born in 1854. He had a practical training in engineering at an early age, and entered Cambridge in 1872, where he graduated as Eleventh Wrangler in 1876.

In 1877, Mr. Parsons was apprenticed to the firm of Sir W. G. Armstrong. He was several years with Messrs. Kitson, of Leeds, and then became partner in the firm of Clarke, Chapman and Co., of Gateshead-on-Tyne, devoting himself to the electrical department of the firm. He resigned his connection with this firm in June, 1889, and is now head of the firm of Messrs. C. A. Parsons and Co., Heaton Works, Newcastle-on-Tyne, who are manufacturers of the improved steam turbine dynamo, unipolar dynamos, alternators, transformers, search-light mirrors, projectors, arc lamps, and all descriptions of electrical plant. Mr. Parsons is Managing Director of the Newcastle and District Electric Lighting Company and of the Cambridge Electric Supply Company, and is a Director of the Scarborough Electric Supply Company. He has read several Papers before learned societies.

PAXMAN, James N., A.M.I.C.E., M.I.M.E.
Born at Colchester in 1832.

Mr. Paxman left school at the age of 15 years, for the purpose of learning in his father's works the business of engineering and millwrighting. At the age of 19 he was requested by Mr. Charles Marriage to assist him in the management of Messrs. Catchpool and Sons' engineering and iron founding business. To this he assented. For two years the joint management continued; but at this period Mr. Marriage removed to another part of England, and at the age of 21 Mr. Paxman was appointed to the entire charge, and being particularly fond of the work, and giving his entire study to the perfecting and economical working of the steam-engine, by his energy a good and prosperous engineering trade was the result. The work consisted chiefly in making and repairing steam engines and generators. It is well to mention that at the age of 19 Mr. Paxman visited the Great Exhibition of 1851, and to this Exhibition he owes the chief cause of his success in life, inasmuch that he was so deeply impressed with the importance of his profession that he resolved to devote his entire energies to its study and practice. In 1861, the Stour Navigation Commissioners, with Mr. Stebbing as chairman, had tried to work their traffic on the river with a steam tug, and had made for this purpose a tug boat. Many experiments were carried out by several makers, but from the difficult bends in and shallowness of the river they had almost despaired of succeeding, when Mr. E. Salter, C.E., of Sudbury, advised the Commissioners to consult Mr. Paxman, who inspected the river, and suggested a favourable scheme. He was instructed to proceed with the work, and the result was practically most successful, and did both Mr. Paxman and the Commissioners great credit. In 1865 Mr. Paxman tried very hard to induce his employers to build suitable premises and procure suitable tools for their increased business, but, failing to do so, he resigned his situation with Messrs. Catchpool and Sons to commence business in connection with Messrs. C. M. and H. M. Davey. Premises were taken in the centre of Colchester, and a good business carried on. They had not been at work long when through wet seasons, Mr. Paxman was induced to bring out his patent for a machine for drying grain and other materials by steam. For this

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THOMAS PARKER.

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invention the Royal Agricultural Society of England awarded the firm one of their much-coveted medals given for new and useful inventions. In 1869 Mr. Paxman brought out his patent vertical boiler with circulating tubes and deflector, now known as the "Paxman" Patent Vertical Boiler, and in the trials of engines and boilers at the Oxford Show, in 1870, this proved to be the best known vertical boiler. Again in 1872, at Cardiff, Mr. Paxman was to the front at the great and, perhaps, most complete public trial of steam-engines and boilers ever made up to that date. (See the Royal Agricultural Society's *Journal* of that date.) In 1875, at the Taunton Show Trial, this vertical boiler was again tested by the engineers to the Royal Agricultural Society of England, and gave the best results of any vertical boiler on record of that date. One of Mr. Paxman's firm's engines was selected to drive a portion of the machinery at the International Exhibitions held at South Kensington in the years 1874 to 1877, and at the Philadelphia Exhibition the Paxman engine gained the only medal awarded to England in its class. In Sweden the firm's machinery had gained a great reputation, and at the Swedish Exhibition in 1871 Mr. Paxman had the honour of being introduced to King Oscar, and receiving from his own hands a gold medal. The King further graciously honoured him with a call. In 1878 Mr. Paxman patented his automatic cut-off gear, combined with a governor for effectually regulating and controlling the speed of a steam-engine. The same year the Messrs. Davey retired from the business, their interest being taken over by Mr. Paxman and his partner. At this time Mr. Paxman had introduced several improvements in the diamond industry of Kimberley, and in 1881 he undertook a journey to the Kimberley Diamond Fields, where his firm had supplied several hundred steam-engines, boilers, &c. The result of that visit was improved machinery, and Mr. Paxman read a Paper at the Institute of Civil Engineers relative to the Diamond Fields of South Africa. At the International Electric Exhibition, Crystal Palace, 1882, Mr. Paxman's engine ran so steadily and perfectly that it was retained by the jury for carrying out their experiments, and they specially commended it for its efficient and regular performances, and awarded him a gold medal. In 1883 his firm were requested to undertake the supply of motive power for driving the electric light machinery at the celebrated International Fisheries Exhibition, and were awarded a gold medal. In 1884 they were again selected for the Health Exhibition, in 1885 for the Inventions Exhibition, and in 1886 for the Colonial and Indian Exhibition, receiving on each occasion a gold medal. The large plant of steam-engines and boilers which were to be seen running there so constantly and perfectly have in large measure contributed to the success of this light. At the great competitive trial held in connection with the Royal Agricultural Society of England's Show at Newcastle, in July, 1887, Mr. Paxman carried off both the prizes offered for compound and non-compound portable engines. These trials were open to all makers. It was not so much the value of the prizes, but Mr. Paxman was anxious to show that even a better result than that obtained by him at the Cardiff trials in 1872 could be made, and the record established by him at the Newcastle trials is an extraordinarily good one, being much above those of Cardiff, and will be difficult to beat. In 1888 a competitive trial of steam-engines was invited, and again Mr. Paxman's engine thoroughly established his record at Newcastle, and was awarded the only gold medal given for steam-engines and boilers at the Society of Arts' trials (London). In 1887, Mr. Paxman was consulted by the Compagnie Parisienne, at St. Fargeau, Paris, as to a system of transmitting power by compressed air, and he designed and laid down at St. Fargeau a very large plant of steam-engines and boilers working air compressors direct for distributing air through the streets of Paris for driving prime movers. The whole plant has now been most satisfactorily at work for several years. He received a further order for another large plant for the same company, but before the work could be completed the Paris Municipality, in order to keep English houses out of the market, passed a resolution prohibiting the use of English-made machinery for the compressed air installations. Mr. Paxman much regretted this event, because the first plant had given him considerable experience, and he had hoped to introduce improvements which would have made the next plant still more efficient; but experience has proved that notwithstanding that the plant designed and arranged by Mr. Paxman was the pioneer of large plants for this kind of work, yet it remains for design, workmanship, economy, efficiency, and durability, amongst the best that are now in use. His firm was selected by the Executive Committee to supply the whole of the steam-power required for driving the machinery in the British Section of the Paris Exhibition, 1889, and his engines were selected for supplying a large portion of the motive-power in the French Section of this Exhibition, and also at the Italian Exhibition (London). In 1890 his firm were selected to provide the supply of motive power for driving the electric light machinery at the Royal Military Exhibition (London), French Exhibition (London), and were awarded gold medals. At the Mining and Metallurgical Exhibition (London), 1890, they also received a gold medal. Mr. Paxman is not one of those who can rest and be thankful, but is ever on the alert. It is well known that at engine trials he is one of the most severe competitors, and his great experience and sound practical knowledge of the requirements of steam generators and steam-engines is second to none. To-day the firm of which Mr. Paxman is the sole proprietor ranks as one of the very largest in the kingdom. Several institutions in Colchester owe much to him and to his influence and exertions, and he has rendered great service to the borough in the successful efforts he has made in permanently establishing the Albert School of Science and Art in Colchester. And, as a proof of his popularity in his native town,

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we may add that he was unanimously elected by both political parties as mayor for the municipal year of 1887-1888. At the conclusion of his year of office he was presented by his fellow townsmen with a solid silver dessert service, weighing 170 ounces, in recognition of the spirited manner in which he carried out the mayoralty. Mr. Paxman is an Alderman and a Justice of the Peace.

PENDER, Sir John, G.C.M.G., M.P., son of the late James Pender, of the Vale of Leven, Dumbartonshire. Born 1816; J.P. for Kent, Middlesex, and Lancashire, and for the counties of Denbigh, Argyll, and Linlithgow; a D.L. for Lancashire; a Fellow of the Imperial Institute, and of the Royal Geographical Society of Scotland, of the Royal Societies of England and Scotland, and of the Scottish Antiquarian Society; Chairman of the Eastern, Eastern Extension, South African, Brazilian Submarine, African Direct, West African, Direct United States, Direct Spanish, Pacific and European, and European and Azores Cable Companies, of the Globe Telegraph and Trust Company, and of the Metropolitan Electric Supply Company; also Trustee of the Submarine Cables Trust; married, first, 1840, Marion, daughter of Mr. James Cearns, and secondly, 1851, Emma, daughter of Mr. Henry Denison, of Daybrook, Notts. (Lady Pender died in 1890); M.P. for Totnes, 1865-1866, Wick Burghs, 1872-85 and 1892; also contested Linlithgowshire, 1868, Wick Burghs, 1885, Stirling Burghs, 1886, and Govan, 1889. Residences—18, Arlington-street, S.W.; Foot's Cray Place, Foot's Cray, Kent; Middleton Hall, Linlithgowshire. Clubs—Brooks's, Reform, City, and Garrick.

Sir John Pender was educated at the High School, Glasgow, and after a successful career in Manchester he made the extension of submarine telegraphy his principal study, and the remarkable growth of the Companies over which he presides, is an eloquent testimony to his skill and ability in this direction. On the formation of the first Atlantic Cable Company, Sir John was one of the original 345 contributors of £1,000 towards the expenses of the necessary experiments, and, as a Director of that Company, he shared the failures and disappointments which for eight years baffled all attempts to bring the scheme to a successful issue. The snapping of the cable of 1865 in mid-ocean during the now historic voyage of the "Great Eastern" proved the financial ruin of the Atlantic Company. Many of the original supporters of the enterprise were dead, many more were utterly discouraged by repeated failures, and, with no hope of assistance from the outside public, the abandonment of the project was imminent. But, fortunately, the faith of Sir John Pender and a few others in its ultimate success remained unshaken. Through their efforts the Anglo-American Company was formed, and negotiations were opened with Messrs. Glass, Elliot and Co. and the Gutta Percha Company for the manufacture of a new cable of greater strength and value than any previous one; but the latter Company, discouraged by previous experience and unwilling to lay aside its ordinary business for one speculative undertaking, refused to proceed without a guarantee. It was at this crisis that Sir John, with the courage of genius, offered his personal guarantee for a quarter of a million sterling, and this being accepted, the two manufacturing Companies were amalgamated under the name of the Telegraph Construction and Maintenance Company, with Sir John as Chairman. The subsequent history of the enterprise is well known. Not only was the new cable successfully laid, but the broken one was recovered, and, by common consent, Sir John now became the recognised leader in this and all kindred undertakings. To his energy was due the formation of that great system of Eastern telegraphs which, now under the names of the Eastern and Eastern Extension Telegraph Companies, link together the whole of our Asiatic and Australasian possessions, and through his exertions the cables of the Eastern and associated Companies surround the great continent of Africa. Successful as a pioneer, Sir John's sound commercial instincts have stood him in good stead as an organiser and administrator. The encouragement and support which he has ever been ready to extend to inventors and men of science have given him the command of all that is newest and best in apparatus. The companies which he controls are models of efficiency and management, and while in the highest degree prosperous to their proprietors, they worthily fulfil the great mission they were designed to further. A striking instance of the work these cables are sometimes called upon to perform occurred in connection with the opening of the Colonial and Indian Exhibition of 1886, when, on the day following that ceremony, the Viceroy of India, the Governor-General of the Dominion of Canada, and the Governors of every British Colony and Dependency issued, by request of the Prince of Wales, a special gazette, containing a verbatim report of His Royal Highness's address to the Queen, of Her Majesty's reply, and also the late Lord Tennyson's ode.

In recognition of Sir John's services to the Empire Her Majesty bestowed upon him in 1888 a Knight Commandership of the Order of St. Michael and St. George, and he has since (in 1892) been promoted to a Grand Cross of the same Order. On the former occasion Lord Derby, then Secretary of State for the Colonies, presided at a complimentary banquet given in his honour.

Sir John Pender's Parliamentary career has been a long and honourable one. While he keenly feels that the integrity of the Empire should be left intact, his motto, "Telegraphs know no politics," gives him great influence on both sides of the House, and enables him, besides safeguarding the interests of the companies he represents, to serve the State, irrespective of party, in many important ways. It should be added that the cause of technical education has in Sir John a warm advocate.

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SIR JOHN PENDER, G.C.M.G., M.P.

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JOHN PERRY.

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In the course of the cruises which Sir John has taken in the interests of the telegraph companies, the Rulers of many of the States he has visited have recognised the services he has been instrumental in rendering to their subjects from time to time, by conferring upon him various high Orders. Among the honours so conferred may be mentioned the Grand Cordon of the Medjidie—the highest decoration which the Sultan can grant to a foreigner—the Knight Commandership of the St. Saviour of Greece, and the Portuguese Orders of the Conception, the Rose, and Grand Cross of the Royal Military Order of our Saviour Jesus Christ. Sir John is also an Officer of the Legion of Honour, this decoration having been conferred upon him by the French Government in 1891, in recognition of his labours in connection with the establishment and extension of Submarine Telegraphy.

In recent years Sir John Pender has devoted much attention to the electric lighting of London, being, as we have before stated, Chairman of the Metropolitan Electric Supply Company, which is the largest undertaking of its kind in this country. The Company at present (1893) supplies upwards of 165,000 lights, and Sir John's success in other electrical enterprises augurs well for its future success.

PERRY, Prof. John, M.E. (Master of Engineering), D.Sc., F.R.S., Assoc. M.I.C.E Born at Garvagh, in Ulster, in 1850.

Dr. Perry attended the Model School, Belfast. With other school prizes, won a silver medal in natural science; was apprenticed to the firm of Messrs. Coates, of the Lagan and Prince's Dock Foundries, Belfast, going through the drawing office and shops. Gained a mathematical scholarship and the Peel Prize in geometry on matriculating at Queen's College, Belfast, and afterwards many college prizes and exhibitions, graduating in 1870 as Bachelor of Engineering in the Queen's University of Ireland with first honours, gold medal, and Peel Prize. Gained Whitworth Exhibitions in 1868 and 1869, and a Whitworth Scholarship in 1870. The honorary degree of Master in Engineering was conferred on him by the University Senate in 1882, and D.Sc. in 1886. Was Lecturer in Physics at Clifton College 1870-74, and there started the first School Physical Laboratory and Workshop, still thriving institutions. Published "Elementary Treatise on Steam" (Macmillan and Co.) in 1873. Was a secretary of the A Section, British Association, 1874; and in that year became Thomson Scholar and hon. assistant to Sir William Thomson in Glasgow. Wrote many of the mathematical and physical articles in Blackie's "Cyclopædia." His first scientific Paper was read before the Royal Society of London early in 1875, on "The Electric Conductivity of Glass as Dependent on Temperature." In partnership with Sir William Thomson, he read a Paper on "Capillary Surfaces of Revolution" before the Royal Society of Edinburgh. In 1875 Dr. Perry went to Japan as joint Professor (with the principal) of Engineering in the Imperial College of Engineering, and returned to England in 1879. In conjunction with Prof. Ayrton he did so much electrical work that Prof. Clerk Maxwell jocularly remarked that the electrical centre of gravity had removed to Japan. The Papers published by the partners since 1876 are too numerous for mention. On Prof. Perry's return from Japan in 1879 he organised the works of Messrs. Clark and Muirhead, introducing large tools, machinery for the covering of wire with gutta percha, &c., and for the testing of dynamo machines. Gained silver medal of the Society of Arts in 1881 for his lecture on "The Future Development of Electrical Appliances," since translated into German by Prof. Wienhold, and published as a separate book. He arranged the system of technological examination in mechanical engineering of the City and Guilds Institute. Delivered a course of Cantor Lectures on hydraulic machinery in 1882. In that year became Professor of Mechanical Engineering and Applied Mathematics at the Finsbury Technical College. His book on Practical Mechanics is well known. He is a member of Council of the Institution of Electrical Engineers and is a Vice-President of the Physical Society. Profs. Ayrton and Perry were appointed joint engineers to the Faure Accumulator Company a few months after it began work, and remained in that capacity until the English patents were disposed of. They lighted, among other places, the Grand Hotel, Charing Cross; arranged the driving of tramcars and tricycles, experimenting on accumulators at the manufactories in Liverpool and Paris. Dr. Perry's more important inventions, made in conjunction with Prof. Ayrton, are:—Permanent magnet and spring ammeters and voltmeters, with and without commutators; solenoid and shielded ammeters and voltmeters; the secohmmeter; twisted strip voltmeter; spring balances; resistances for use with strong currents varied by foot and hand; power-meter; ohmmeter; electromotors; switches for use with accumulators, and arrangements for lighting railway trains; photometers; dynamometer couplings and transmission and absorption dynamometers; the governing of motors and dynamos; an electric tricycle; an electric railway system with friction gearing, contact boxes and locomotives, forming part of the general system belonging to the Telpherage Company, Limited. Of their inventions which are not commercially valuable may be mentioned their arrangement for "Seeing by Electricity;" their multireflex arrangement exhibited at Paris; their ballistic galvanometer, and their many forms of apparatus employed in the teaching of electricity, &c. On the death of Prof. Fleeming Jenkin, Dr. Perry became engineer of the Telpherage Company, and from July to October, 1885, superintended the erection and setting to work of the telpher line at Glynde, in Sussex. His lecture at the London Institution describing this telpher line was published in *The Electrician*. In June, 1885, Dr. Perry was elected to a Fellowship of the Royal Society. In April, 1889, the Ayrton and Perry partnership was formally dissolved. Since the dissolution Prof. Perry has written many scientific Papers, delivered the Operatives' Lecture of the B. A.

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meeting at Leeds on "Spinning Tops," and taken out many patents, the most important being for a quick-speed indicator for steam-engines and an electrical supply meter.

POMEROY, Henry. Born at Westbury, Wiltshire, April 10, 1841.

Mr. Pomeroy was educated at the Diocesan School, Westbury; and afterwards privately at Hale Rectory, near Salisbury, by the late Rev. G. J. Goff, M.A. Oxon.; entered the engineer's office of the Great Western Railway Company at Westbury in 1856, and in the following year was transferred to the telegraph branch of the same company under Mr. Spagnoletti. Entered the Electric and International Company's service at Bristol in 1858, and served under Mr. R. S. Culley; was stationed at the Dutch Government Telegraph Office, Amsterdam, for six months, in 1860; returned thence to the Foreign Office, London, and then to Bristol; subsequently went to Cardiff in charge of the Repeaters on the Irish Cable circuits; afterwards to Worcester to instruct the telegraphists there in the Morse system; crossed to Dublin in 1862, where he joined the engineering branch in 1863; was subsequently engaged on board the old cable ships, "Monarch" and "Robert Lowe," assisting the late Captain Blacklock in connection with the frequent repairs of the cables off the Irish coast, near Greenore; was later on engaged on two new cable-laying expeditions, by the ss. "Dacia," under Mr. Lumsden, between Abermaur, Fishguard, and Blackwater; transferred to the Post Office in January, 1870; appointed superintending engineer in 1878; and has now charge of the Southern District of Ireland, with headquarters at Cork. Mr. Pomeroy was the first to use pure hard-drawn copper wire for city telephone systems, and one of the first to advocate its use for ordinary telegraph lines; he has also introduced the Earthenware Knob Insulator, which, being of an unbreakable nature, forms a great protection against malicious damage from stone-throwing on outlying road lines. Mr. Pomeroy has devised and introduced an improvement in the Neale's Acoustic Dial, known as the Dial Sounder; also a key which, with the receiving instrument, forms a universal set, by means of which, without any adjustment, communication can be carried on on double or single current sounder, Bell, or single-needle circuits.

POPE, Ralph Wainwright. Born at Great Barrington, Mass., August 16, 1844.

Early in life Mr. Pope developed a taste for mechanics, and having learned the operation of the Hughes type-printing telegraph in 1858, has been closely identified with electrical interests during his life. He entered the railway service in 1859, but owing to the abnormal demand for practical Morse telegraphers caused by the civil war of 1861, he soon after became one of the skilled operators on the staff of the American Telegraph Company. Arduous night-work impaired his health, and in 1865 he joined the force of the Collins' Overland Telegraph, spending a year in the wilds of British Columbia. Upon his return he again devoted his attention to electrical pursuits, and spent ten years in the Gold and Stock Telegraph Company's service. When his brother, Franklin L. Pope, assumed the editorial chair of *The Electrician and Electrical Engineer*, he became his associate, and found a congenial field in exercising that literary taste which had gradually assumed form during his long connection with telegraph interests. While holding this position he was, in 1885, elected Secretary of the American Institute of Electrical Engineers, the rapid growth of which made it necessary, in 1887, that he should devote to it the greater part of his attention, which he did at some personal sacrifice, hoping in this manner to aid in building up a creditable organisation. Mr. Pope is still secretary of the Institute. In 1888 he established a monthly journal called *Electric Power*, in association with his brother, Henry W. Pope, and Mr. George H. Stockbridge. At the Chicago Exhibition in 1893 he was appointed one of the judges in the department of Electricity, and was elected Chairman of the Sub-Committee to which was assigned the groups of telegraph, telephone, and signalling apparatus. He has given much attention to association work, and was the organiser of the Telegraphers' Protective League and the Gold and Stock Life Insurance Association.

POYNTING, Prof. John Henry. Born September 9, 1852, at Monton, near Manchester, son of the late Rev. T. Elford Poynting, Unitarian Minister, and educated first at a private school conducted by his father, and afterwards at Owens College, Manchester.

Prof. Poynting went to Trinity College, Cambridge, in 1872, graduating in the Mathematical Tripos in 1876, and being elected a Fellow of Trinity College in 1878. He took the degree of Doctor of Science, at Cambridge, in 1887. He was Demonstrator in the Physical Laboratory, at Owens College, under the late Prof. Balfour Stewart, from 1876-9, and was appointed Professor of Physics at Mason College, Birmingham, in 1880, which post he still holds. Prof. Poynting has contributed Papers to the *Phil. Trans.* on "The Transfer of Energy in the Electromagnetic Field" (1884), on "The Connection between Electric Current and the Electric and Magnetic Inductions in the Surrounding Field" (1885), and on "A Determination of the Mean Density of the Earth and the Gravitation Constant by Means of the Common Balance" (1891). In 1888 he was elected a Fellow of the Royal Society.

PREECE, W. H., C.B. Born 1834, near Carnarvon, North Wales. Educated at King's College, London. Entered Mr. Edwin Clark's (M.I.C.E.) office in 1852. Appointed to the E. and I. T. Co. 1853. Superintendent of the Southern District of E. and I. T. Co. 1856, and of L. and S.-W. Railway Co. in 1860; also Engineer Channel Islands Telegraph Company 1858; transferred to Post Office as Divisional Engineer

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WILLIAM HENRY PREECE.

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1870; appointed Electrician, 1877; Engineer-in-Chief and Electrician, 1892.

The remarkable gifts of Mr. Preece as a lecturer on science have brought him prominently before the general public, who crowd to the halls of the Society of Arts or the Royal Institution whenever he is discoursing on some of the electrical topics of the hour, or explaining the mysteries of some inventive marvel. His original researches for the furtherance of the special science which he cultivates, and his various practical inventions, have also won the suffrage of his fellow workers, and have given him a leading place amongst them. Moreover, the active interest which he manifests in all that relates to his profession, and the genial good-humour of the man, are of themselves enough to make him popular with electricians. Mr. Preece is consulting electrician to the British and Colonial Governments. He is a Member of the Council of the Institution of Civil Engineers, to which he was elected in 1859. He is a Fellow of the Royal Society, a member of the Physical Society, Meteorological Society, the Royal Institution, the British Association, and the Society of Arts. He was President of the Society of Telegraph-Engineers for the year 1880, and he was re-elected President of the same Society (now called the Institution of Electrical Engineers) for 1893. He is a Fellow and a Member of the Council of King's College. He was made a C.B. on January 1, 1894. Mr. Preece is the inventor of a new method of duplex telegraphy, patented in 1855; a new mode of "terminating" wires (1858); working miniature signals by electricity to assimilate electric signals with outdoor signals on railways (1862); the application of electricity to domestic telegraph purposes (1864); the application of electricity for signalling between different parts of a train in motion (1864); locking signals on railways by means of electricity (1865); improvements in railway signalling to counteract the effects of lightning (1873); a new telephone (1878); improved communication between passengers and guard (1882). He is a joint author with Mr. (now Sir James) Sivewright of a "Text-book of Telegraphy," with Dr. Maier of "The Telephone," and with Mr. Stubbs of a "Manual of Telephony"; has edited several works, and written many Papers for the scientific press, among which latter the following may be mentioned:—Before the British Association: "The Telephone," "Recent Progress in Telegraphy," "Lightning Protectors," "Recent Progress in Telephony," "Telegraphic Intercommunication," "Domestic Electric Lighting," "On the Watt and Horse-power," "On the Use of Secondary Batteries for Telegraphy," "On the Law of Incandescence and its Relation to Current," "The Relative Merits of Iron and Copper Wire" (1885), "On the Coefficient of Self-Induction in Telegraph Wires" (1887), Presidential Address to the Mechanical Section at the Bath Meeting (1888), "On the Relative Effects of Steady and Alternate Currents on Different Conductors" (1889), "On the Character of Steel used for Permanent Magnets" (1890), "On the Form of Submarine Cables for Long-Distance Telephony" (1890), "The London-Paris Telephone" (1891), "On the Dielectric of Condensers" (1892). Before the Society of Arts: "On the Phonograph," "Cantor Lectures" (1879), "Recent Advances in Telegraphy," "Recent Advances in Electric Lighting," "Electric Lighting at the Paris Exhibition," "Electrical Exhibitions," "On the Progress of Electric Lighting," "Electric Lighting in America," "Domestic Electric Lighting," "Fifty Years' Progress in Telegraphy," "On Secondary Batteries." Before the Royal Society: "Studies in Acoustics" (jointly with Mr. Stroh), "On Some Thermal Effects of Electric Currents," "On the Conversion of Radiant Energy into Sonorous Vibrations," "The Effects of Temperature on the Electromotive Force and Resistance of Batteries," "On a New Standard of Illumination and the Measurement of Light," "A Peculiar Behaviour of Glow Lamps," "On Charging Secondary Batteries," "The Limiting Distance of Speech by Telephone." Before the Society of Telegraph-Engineers: "On a New Telegraph Wire Gauge," "Telegraphy—Its Rise and Progress in England," "On the Advantages of Scientific Education," "On Lightning and Lightning Conductors," "On the Block System of Working on Railways," "On Shunts, and their Application to Electrometric and Telegraphic Purposes," "On the Measurement of Currents," "On the Phonograph," "On the Connection between Sound and Electricity," "On Winding Electro-Magnets," "On the Durability of Iron Wire," "On Radiophony," "The Behaviour and Decay of Insulating Compounds," "A Visit to Canada and the United States," "Long-Distance Telephony," "Delany's System of Synchronous Multiplex Telegraphy." Before the Institution of Electrical Engineers: "On Some Points connected with Mains for Electric Lighting," "On the Specification of Insulated Conductors for Electric Lighting and other Purposes" (1891). Before the Physical Society: "On Some Physical Points connected with the Telephone," "The Phonograph." For the Royal Institution: "On the Applications of Electricity to the Protection of Life on Railways," "The Telephone," "On Duplex and Quadruplex Telegraphy," "On Wheatstone's Telegraphic Achievements." For the Institution of Civil Engineers: "On the Maintenance and Durability of Submarine Cables in Shallow Waters," "On Railway Telegraphs and the Application of Electricity to the Signalling and Working of Trains," "On the Best Means of Communicating between the Passengers, Guards, and Drivers of Trains in Motion," "On the Progress of Telegraphy" (lecture), "On Electrical Conductors," "On the Sanitary Aspects of Electric Lighting" (Sanitary Institute, 1890), "Gas *v.* Electricity" (Association of Municipal and County Engineers, 1891), and "On the Utilisation of the Waste Forces of Nature" (lecture, 1892).

PROCTOR, C. Faraday. Born at Newcastle-on-Tyne, February 16, 1861.

After serving a regular engineering apprenticeship with Messrs. Watson and Sons, Newcastle-on-Tyne, he entered the private labora-

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tory of Mr. Swan to assist in the development of his lamp. In 1881 Mr. Proctor was sent to Paris with Mr. Swinburne to start a lamp factory, they having just made a few lamps in Antwerp for the purpose of securing patent rights (probably the first practical incandescent lamps made on the Continent, November, 1881). In November, 1882, Mr. Proctor returned to England to introduce some improved machinery and to assist in the enlarging of the works at Newcastle and Low Fell. In November, 1884, he again went to the Continent to assist in the re-installing of the Lille factory of the Swan Company, which had been entirely destroyed by fire; he was appointed manager of these works in April, 1886, which post he held until the amalgamation of the Edison and Swan Continental Companies, who, under the title of Compagnie Générale des Lampes Incandescentes, decided to build a new factory at Ivry-sur-Seine, of which Mr. Proctor was appointed engineer. He then visited the various factories of both companies before taking charge of the lamp manufacture. He was presented with the bronze medal by the Jury of the Paris International Exhibition of 1889 for incandescent lamp manufacture, his company having obtained the highest award for lamps. On April 14th he rejoined the Edison-Swan Company, returned to England, and shortly afterwards was appointed assistant-manager of their works. In February, 1885, Mr. Proctor discovered the conductability and decomposition of flint, or lead glass, by the passage of an electric current through it while hot. In September, 1891, he registered a new form of lamp, having many advantages over the old form, which it is rapidly displacing. During his eleven years' connection with the incandescent lamp manufacture he has introduced many improvements in the machinery, and especially in the exhausting of the lamps, which, from being one of the most difficult departments, is now the most easy, his new pump obtaining the very highest vacua in less than fifteen minutes. Mr. Proctor is a Member of the Société Internationale des Electriciens (Paris), and an Associé de l'Association des Ingénieurs électriciens sortis de l'Institut Montefiore (Liége, Belgium).

PULUJ, Johann, Ph.D., Professor of Physics and Electricity at the German Technical High School at Prague. Born in 1845. Educated at the Vienna University.

In 1875 he became assistant at the Royal Marine Academy of Fiume, and in the following year visited the University of Strasburg, where he took his degree of Ph.D. In 1877 Dr. Puluj was assistant in the Physical Laboratory, and Docent of Experimental Physics at the University of Vienna, where for six years he lectured on the kinetic theory of gases and heat. In 1883 Dr. Puluj took up the practical side of electricity, and became manager of the Vienna branch of the firm of Ganz and Co. A year later he was appointed consulting electrician of the Waffenfabriksgesellschaft in Steyr, and manager of a factory where a glow-lamp of his was made, which was used for lighting the Electrical Exhibition held in Steyr in 1884. This Exhibition brought Dr. Puluj into prominence and he was appointed to the professorship of Physics and Electricity in the Technical High School at Prague by the Minister of Instruction, who has added to the laboratory an electrical department fully equipped with machinery and apparatus. In 1889 Dr. Puluj was elected Rector of the High School. Dr. Puluj was also assistant in the Physical Laboratory of the University, where he conducted a series of difficult experiments on the relation between the internal viscosity of gas and its temperature, the results of which, together with other works of his, are set out in the Reports of the Vienna Academy of Science. An abstract of his work on "Strahlende Materie" was published eight years after its first appearance in the *Memoirs* of the Physical Society of London under the title "Radiant Electrode Matter and the so-called Fourth State." Amongst other physical works Professor Puluj has published the following electrical treatises:—"The Unipolar Induction" (1888); "A Telethermometer" (1889); "Measurement of Temperature in the Bore-hole at Sauerbrunn by the Telethermometer" (1890); "Self-induction, and its Effects," and "Measurement of the Co-efficient of Self-induction by an Electrodynamometer and an Inductor" (1891); "The Effects of Sinusoidal Electromotive Forces having the same Direction in a Conductor of Inductance" (1891 and 1893); "A Method of Measuring the Difference of Phases of Harmonic Alternate Currents"; "A Treatise on the Difference of Phase of the Impressed Electromotive Force, and the Difference of Potential in a Branching-point of a Circuit using Harmonic Alternate Currents" and "A Phase Indicator, and some Measurements with it" (1893). Dr. Puluj is President of the Elektrotechnischer Verein in Prague, and is a member of several scientific societies.

RAVENSHAW, Henry W., A.M.I.C.E. Born in 1858.

Having served three years' pupilage in the Great Western Railway Company's locomotive shops at Wolverhampton and Worcester, from 1880 to 1883, Mr. Ravenshaw worked as draughtsman in Middlesborough, London, and Birmingham. In 1883 he was at the School of Telegraphy, Hanover-square, leaving there to go to Messrs. Edmunds and Co. as draughtsman. He has remained with the same firm (now known as Messrs. W. T. Goolden and Co.) in charge of their dynamo department ever since.

RAWSON, Frederick Lawrence, son of Sir Rawson William Rawson, K.C.M.G., C.B., and grandson of Sir William Rawson, was born at the Cape of Good Hope, July 27, 1859.

Mr. Rawson spent his early life abroad, returning to England for his education at Cheltenham and at Westminster School, at both of which places he was prominent in mathematics, natural science, and drawing. At the age of fifteen he became a pupil of Mr. C. F. de K. Steuart, during which period he went through the shops of Messrs. T. Brassey (Lord Brassey) and Co., of

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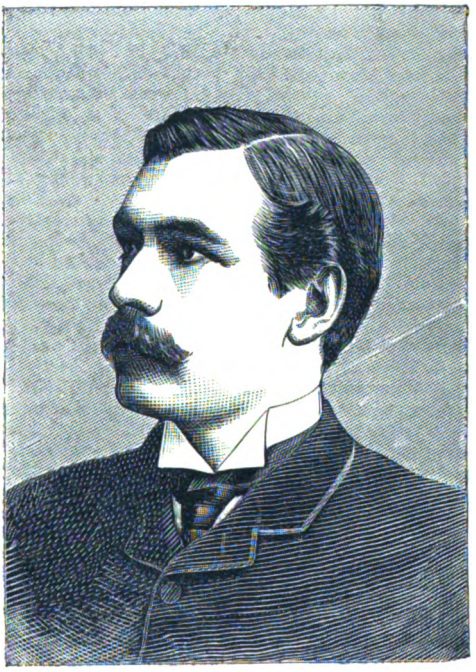

FREDERICK L. RAWSON.

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Birkenhead. During the latter portion of his time he acted as resident engineer for the contractors at the Seacombe Ferry Works, whence he was called to London to work for The Electric Lighting Company, just then formed, under Mr. Steuart, later on acting as sole engineer. Whilst thus engaged, amongst other electric lighting work he took part in the Electric Lighting Exhibition at the Albert Hall. After that time he took charge of Mr. Steuart's office, and together with him was the first to report, amongst other systems, upon the Brush system of electric lighting for Baron Erlanger. He also during this time acted as engineer to Messrs. Perry and Co., contractors for the Donna Theresa Christina Railway. In 1881 Mr. Rawson went into partnership with Mr. O. E. Woodhouse, who retired from business at the end of 1885, and ultimately died in September, 1887. Between 1885 and 1886 three companies—the Woodhouse and Rawson Electric Contract and Maintenance Company, Limited, of Lancashire, Yorkshire, and Cheshire, the Woodhouse and Rawson Electric Supply Company of Great Britain, Limited, and the Woodhouse and Rawson Electric Manufacturing Company, Limited—were formed, they being practically partnerships working under the Limited Liability Acts. Of these Mr. Rawson was chairman of two and managing director of one. In 1887, just before Mr. Woodhouse's death, Woodhouse and Rawson, Limited, was formed, taking over the remainder of the business, and giving founders' shares for the goodwill and patents. Two years later Woodhouse and Rawson United, Limited, was formed, taking over all the old companies, and the works of C. L. Baker and Co., Limited, at Manchester, and later taking over the Kidsgrove Foundry, near Crewe, Mr. Sergeant's Electric Launch Building Works, Messrs. Jensen's Electric Bell business and others. Mr. Rawson is a member of the Institution of Electrical Engineers, the Society of Engineers, and the Société Internationale des Electriciens, and an Associate of the Institution of Civil Engineers. He is also the electrical member upon the committee of the Association for the Protection of Telephone Subscribers. Mr. Rawson has been prominent in the athletic world.

RAWSON, William Stepney, M.A. (Oxon.). Born 1854. Educated at Westminster School, and Christ Church, Oxford.

Mr. Rawson took his degree in the mathematical schools (1st Class, Moderations; 2nd Class, Final). After leaving Oxford he entered the scholastic profession for five years; but, compelled by ill health to abandon this, he joined, in 1882, the firm of Woodhouse and Rawson, of which his brother was a partner. At this period the firm was commencing the manufacture of incandescent lamps, and Mr. Rawson applied himself almost entirely to details in connection with this manufacture, and with photometry and standards of light; and the result of his investigations was that the firm took in hand the manufacture of Mr. A. V. Harcourt's well-known Pentane standard lamps. The manufacture of incandescent lamps having been stopped by the firm on account of patent rights, Mr. Rawson undertook for a time the investigation of the Welsbach Incandescent Gas Lamp, and succeeded in overcoming one of the greatest difficulties in its practical application by finding a method of transporting safely the fragile "mantles" which are to be rendered incandescent. Since 1887 Mr. Rawson has been employed by the Company to report upon the various processes which have been put before them, and he is also closely connected with the technical details of the various branches of the Company. He is a member of the Institution of Electrical Engineers, the Physical and other scientific societies.

RAYLEIGH, The Rt. Hon. Lord, Sec. R.S., son of the second Baron Rayleigh, of Terling Place, Witham, Essex. Born 1842.

Educated at Torquay under Mr. Warner, Lord Rayleigh entered as a Fellow Commoner at Trinity College, Cambridge, in 1861. In 1865 he graduated in the Mathematical Tripos as Senior Wrangler, and was awarded the first Smith's Prize. In 1866 he obtained a Fellowship at Trinity. Lord Rayleigh's works in physics has been of a varied and thorough character. In the years 1871 and 1872 he contributed a series of valuable Papers on Optics to the *Philosophical Magazine*, the results of which may be summed up as follows:—The blue colour of the sky is due to the scattering of light of the shorter wave lengths by the finer particles suspended in the air. Lord Rayleigh showed that the colour of this light and its polarisation could be satisfactorily accounted for on the undulatory theory; and further that to explain the observations Fresnel's hypothesis as to the nature of the vibrations and their relation to the plane of polarisation, and not that of Neumann and MacCullagh, must be assumed. Many other points of interest were discussed; in fact, these Papers, together with those of Sir G. Stokes, sum up the whole of what was then known of the dynamics of optics. In 1873 Lord Rayleigh became a Fellow of the Royal Society, and in the same year he contributed a series of Papers to the *Philosophical Magazine*, dealing with various theorems relating to vibrating systems in general. In a Paper on "Resonance," published in the *Philosophical Transactions* for 1871, Lord Rayleigh first developed a method of calculating approximately the resistance of conductors of any given form. Some of the consequences of self-induction and the effects of rapidly alternating currents in producing magnetism are amongst the subjects discussed in various Papers dealing with electromagnetic phenomena, which were published about this date. In 1877-78 a two-volume treatise on the Theory of Sound was published. In 1879 Lord Rayleigh was called on to succeed Clerk Maxwell at Cambridge, where he devoted himself to the task of completing the organisation of the then newly-founded Cavendish Laboratory. Under his supervision a system of practical instruction in Experimental Physics was devised, and it was during the five years

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also that he was at Cambridge that the various electrical standards were accurately determined. The B.A. unit in terms of the ohm was given in 1883 as 0·9868; later on the electro-chemical equivalent of silver was found to be 0·0011179, and the electromotive force of the Clark cell, prepared and set up as directed, was found equal to 1·4345 volts at 15°C. Thus, by a painstaking series of investigations, requiring the highest experimental skill, Lord Rayleigh determined while at Cambridge the three fundamental units of resistance current and electromotive force. In 1882 Lord Rayleigh was President of Section A of the British Association, and in 1884, at Montreal, he occupied the Presidential chair. In 1885 he succeeded Sir G. Stokes as one of the Secretaries of the Royal Society, and a few years later he became Professor of Natural Philosophy at the Royal Institution in succession to the late Prof. Tyndall. Papers on a large variety of subjects continue to flow from his pen.

RIES, Elias Elkan. Born at Randegg, Baden, Germany, on January 16, 1862.

Mr. Ries was taken to the United States by his parents in 1865, and was educated in the public and technical schools of New York, and Baltimore, Md. While yet a mere child Mr. Ries gave evidence of considerable inventive ability. Before his ninth year he had suggested a number of improvements in the machinery and processes employed in his father's boot factory, several of which were adopted and put into practical use. On leaving school in 1876 Mr. Ries took up the study of telegraphy, which he subsequently practised as an operator in the employ of the Gold and Stock and Western Union Telegraph Companies. During this time he made and experimented with, but failed to patent, a number of inventions relating to multiplex telegraphy, telegraphic and telephonic apparatus, current regulators, &c., some of which have since been patented by others and come into extensive use. In 1881, becoming impressed with the prospective importance of the electric lighting industry, then in its infancy, Mr. Ries entered the employ of the United States Electric Light Company, and was employed in the mechanical and lamp departments at their New York factory, and while there devised a number of improvements in the manufacture of the lamps. On the removal of the factory to New Jersey he accepted positions with the Fuller Electric Light Company, and subsequently with Bergmann and Co., being engaged at the latter place on incandescent lamp-fixture and experimental work in connection with the Edison electric lighting system. In 1885-6 Mr. Ries contributed a series of articles to the New York *Electrician and Electrical Engineer*, in which he advocated as the proper solution of the overhead wire difficulty, a comprehensive and permanent system of underground avenues or subways sufficiently large to contain, and so arranged as to systematically and properly distribute, not only all present and future electrical conductors, but also to provide for a system of rapid electrical transit, and to afford accommodations for gas and water pipes, sewers, pneumatic despatch tubes, and all other forms of city service. Mr. Ries first made public the result of his experiments with electricity for increasing the frictional adhesion between driving-wheels and rails and other metal surfaces in a Paper read before the American Association for the Advancement of Science in August, 1887, and the results foreshadowed in this Paper have since been fully substantiated and confirmed. In June, 1890, Mr. Ries organised the Ries Electric Speciality Company, of which Company he is the President and general manager, for the purpose of manufacturing his regulating sockets and switches for alternating current incandescent lamps, and other valuable specialities produced by him recently, for which there is a large demand. Some of this apparatus was exhibited at the Crystal Palace Electrical Exhibition of 1892, and attracted much attention. Mr. Ries is likewise consulting electrician to the Ries Electric Traction and Brake Company of Baltimore, Md., which controls his electric traction increasing and braking patents. Mr. Ries has for some years past given much attention to the subject of alternating-current railways, of which he was probably the first advocate, and on which he has been granted a number of fundamental patents, whose commercial development is now engaging a considerable portion of his time. In conjunction with Mr. G. J. Scott, he has recently (1893) perfected the Ries and Scott single-phase, high-frequency, self-starting, non-synchronous alternating-current motor, which is at present attracting widespread attention among electricians, and, although as yet new in the art, bids fair to solve the problem of power distribution by alternating currents. Mr. Ries applied for his first patent at the age of seventeen years (1879), and the numerous inventions since patented by him embrace several distinct subjects, chief among which may be mentioned those relating to automatic railway signals and appliances, electric railway-brakes, electric tramway and railway systems, methods and apparatus for increasing traction electrically, dynamo electric generators and motors, electrical transmission and distributing systems, alternating current apparatus, electric heating, electric welding, electric riveting, and metal working, &c. Mr. Ries is a member of the American Association for the Advancement of Science, of the American Institute of Electrical Engineers, of the American Academy of Political and Social Science, and of the American Association of Inventors and Manufacturers.

RIGHI, Prof. Augusto. Born at Bologna in 1850, educated at the Bologna University.

In 1872-3 he was assistant in the department of Physics in the University. He was Professor of Physics from 1873 to 1880 at the Bologna Technical Institute, from 1880 to 1885 at the Palermo University, from 1885 to 1889 at the Padua University, and since 1890 at the Bologna University. In 1875 he was awarded the prize of 1,000 lire by the Società Italiana delle Scienze, in 1886 the same Society voted him the Matteucci gold medal, and in 1891 the

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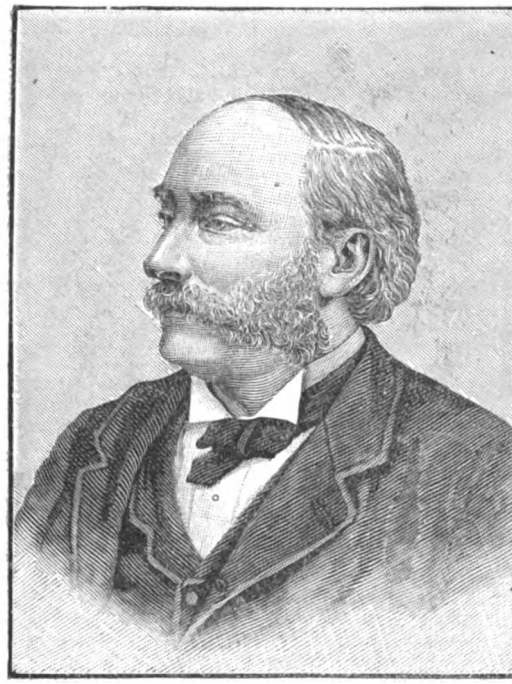

LORD RAYLEIGH.

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Accademia Reale dei Lincei (Rome) awarded him the royal prize. He has published many Papers on Physics, the most important being the following:—"On the Hall Phenomenon in Bismuth" (1883); "On the Change of the Electrical Resistance of Bismuth when placed in a Magnetic Field" (1884); "On the Kerr Magneto-Optical Phenomenon" (1885-6); "On Heat Conductivity in Bismuth when placed in a Magnetic Field" (1887); "Various Memoirs on the Electrical Phenomena caused by Radiation" (1888-9). Prof. Righi is a member of the Lincei Academy (Rome), and of the Academies of Bologna, Palermo, and Turin, a member of the Royal Institute of Sciences at Venice, and is one of the XL. of the Italian Society of Sciences.

ROBERTS-AUSTEN, Prof. W. Chandler, C.B. Born in the year 1843.

In 1861 Prof. Roberts-Austen entered the School of Mines with a view to becoming a Mining Engineer, for which profession, however, it was found that his health was not sufficiently robust. Mr. Graham, then Master of the Mint, secured his services in 1865, and he has been retained at the Mint ever since. In 1869, Mr. Roberts-Austen was appointed Chemist of the Mint, and after accompanying Sir C. W. Fremantle, K.C.B., the then Deputy-Master of the Mint, on a tour of inspection of European Mints in 1870, Prof. Roberts-Austen was in the following year appointed Assayer of the Mint, and subsequently entrusted with the duties of the office of "Queen's Assay Master," which is a post of great responsibility, and of much more importance than is popularly ascribed to it. In 1880 the late Dr. Percy resigned the Chair of Metallurgy at the Royal School of Mines, and Prof. Roberts-Austen was permitted to accept the Professorship in addition to his ordinary duties at the Mint. During the time he has occupied this Chair he has introduced the system of teaching the operations of metallurgy with the aid of small furnaces and "plant," and has organised visits for his students to metallurgical districts, which have been greatly appreciated by them. His "Cantor Lectures," delivered before the Society of Arts, have been translated into French and into Russian. Prof. Roberts-Austen was one of the original promoters of the Physical Society of London, of which he was one of the secretaries and became vice-president. He was appointed by H.R.H. the Prince of Wales a member of the Council of the Inventions Exhibition, and was a member of the British Executive Council of the International Exhibition of Paris, a Juror in the Mining and Metallurgical Group, and received, as Vice-President of the International Congress of Mines and Metallurgy, the Cross of Chevalier of the Legion of Honour. He was made a C.B. in 1890. With regard to his research work, he is at present engaged on a tedious investigation, part of which has already been published in the *Philosophical Transactions* of the Royal Society, the object of which is to trace the relation between the Periodic Law of Newlands and Mendeleef and the action of traces of metals or metalloids on the mass of metal in which they may be hidden. He has already obtained some interesting and important results in connection with this subject, which has always had a singular attraction for him.

ROBINSON, Prof. William, M.E. (Master of Engineering), Assoc.M.Inst.C.E., M.I.E.E., was born at Burt, near Londonderry, December 28th, 1858.

He was educated at the Academical Institution, Derry. During the session 1875-76 he attended Magee College, Derry, and gained first prize in mathematics. On matriculating at Queen's College, Belfast, in 1876, he obtained a mathematical scholarship, and was also admitted by competitive examination to the chemical laboratory under Dr. Andrews. In 1877-9 he studied in the Faculté des Sciences, University of Geneva, taking up Physics and Chemistry. In 1879 and 1880 he attended the engineering classes at Belfast, and each year gained the scholarship as well as first prizes in all the engineering subjects. At the first University examination he obtained first-class honours and the first Peel Exhibition, and in 1881 graduated as Bachelor of Engineering. At that degree examination he stood first in the Queen's University of Ireland, and was awarded first honours with the gold medal and first Peel Prize. In 1882 the Senate of the University conferred on Prof. Robinson the higher degree of Master in Engineering. Afterwards he became assistant to Prof. John Perry. Prof. Robinson's connection with the Technical College, Finsbury, dates from the first starting of the Department of Mechanical Engineering and Applied Mathematics in Cowper-street, where he acted as Prof. Perry's chief assistant, and also studied electricity. Prof. Perry entrusted Prof. Robinson with the book "Practical Mechanics," which he revised and saw through the press. In 1884 he was engaged by Profs. Ayrton and Perry, and enjoyed special opportunities in the testing of electrical instruments and machines. In the same year he was elected an Associate Member of the Institution of Civil Engineers. He is also Member of the Institution of Electrical Engineers, and of the Physical Society. During 1886 he was engaged by the firm of Messrs. Latimer Clark, Forde and Taylor in the practical testing of submarine telegraph cables at the factories, Greenwich, during manufacture. He took the final tests of part of the West African cable before and after shipment, and accompanied the ss. "Scotia" on the cable-laying expedition to the Gold Coast, where he assisted in testing and other work connected with laying the sections from Sierra Leone to Accra, Lagos, Brass, and Bonny. In January, 1887, he obtained the post of Senior Demonstrator and Lecturer in Applied Physics and Electrical Engineering, as chief assistant to Prof. Silvanus P. Thompson, at the City and Guilds of London Technical College, Finsbury. In 1890 he was appointed Professor of Engineering (Mechanical and Electrical) in the University College, Nottingham. Prof. Robinson is author of "Gas and Petroleum Engines," which is the well-known practical Treatise on the Internal Combustion Engine. He gained the Silver Medal of the Society of

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Arts in 1891 for his lecture on "Uses of Petroleum in Prime Movers;" and in 1892 he delivered a course of "Cantor Lectures" on the same subject. He read a Paper on "Petroleum Oil Engines" at the Cardiff Meeting (1891) of the British Association. Prof. Robinson is author of the series of articles on "Hydraulics" and "Pneumatics" in Cassell's New "Popular Educator." During 1892, besides starting the new technical and engineering schools in University College, Nottingham, Prof. Robinson gave a course of lectures on "Applications of Electricity to Coal Mining" to the National Association of Colliery Managers (Midland Branch).

ROSCOE, Sir Henry Enfield, M.P., F.R.S., LL.D., grandson of Roscoe the historian, was born in 1833, and was educated at University College, London, and Heidelberg.

Sir Henry, who was Professor of Chemistry at Owens College from 1856 to 1886, is chiefly distinguished for his investigations and discoveries relative to the chemical action of light, and on the metal vanadium. In conjunction with Prof. Schorlemer, he published the well-known "Treatise on Chemistry" (six volumes). Sir Henry Roscoe is also the author of "Lessons in Elementary Chemistry," which has been translated into many languages, and of "Lectures on Spectrum Analysis." He is an hon. D.C.L. of Oxford, an LL.D. of Cambridge, Dublin, and Montreal, an hon. M.D. of Heidelberg, as well as member of various learned societies, and served on the recent Royal Commission on Technical Instruction, also on the Commission of Inquiry into the Pasteur Method for the Treatment of Hydrophobia; and was, in 1888, appointed consulting chemist to the Metropolitan Board of Works, with a view to the deodorisation of sewage at the Barking outfalls. In 1887 Sir Henry was president at the Manchester meeting of the British Association. He was created an Officer of the Légion d'Honneur in 1889, and delivered the Presidential Address, on October 7th in that year, at the Birmingham and Midland Institute on the subject of M. Pasteur's researches. In 1889 he was appointed member of the Royal Commission on Scottish Universities. He sits in Parliament for the Southern Division of Manchester, and is a Liberal.

ROSS, Owen Charles Dalhousie, M.I.C.E. Born January, 1823.

Mr. Ross received his early education at Darmstadt and Heidelberg; after which, at the age of eighteen, he became pupil to the then well-known but long since deceased civil engineers, Messrs. Manby Brothers, of London and Paris, with whom he proceeded three years later to Spain, as assistant in the construction of iron-works and railways in the Asturias and other parts. At the early age of twenty-three he was appointed chief of a staff of English engineers, and prepared the surveys for many of the principal Spanish railways which now traverse the peninsula, and directed the construction of a main part of the trunk line from Madrid to the Mediterranean, as well as of several other less important railways. Madrid owes its useful lines of tramway which pass through the heart of the city to his initiative and strenuous exertions. Having in 1870 acquired from the Spanish Government a large metallurgical and mining property, upon which there were vast beds of brimstone ore, with adjoining salt deposits and indications of petroleum, the recovery of sulphur from these ores, and the various applications of sulphur and petroleum, involved complicated chemical experiments and studies, to which Mr. Ross attributes his subsequent success in the application of similar principles to the generation of electricity by chemical means. In 1875 he published the results of his experience in a small volume, entitled "Air as Fuel; or, Petroleum Utilised by Carburetting Air and Rendering it Inflammable," in which he described the principles which govern the generation and measurement of heat, with some special economical applications of carburetted air used as fuel and as illuminating gas. He also contributed a Paper on the same subject to the Institution of Civil Engineers, of which he has been a member from the year 1847. Mr. Ross is the inventor of a primary battery, which has been carefully tested and approved by several eminent electricians, amongst others by Dr. J. Hopkinson. In January, 1884, the Royal Institution was successfully illuminated by its means on the opening evening of the session, and in July it was again used and exhibited in public on the occasion of the annual *conversazione* held at King's College by the President of the Society of Telegraph-Engineers and Electricians. A large house in Queen's Gate, South Kensington has been lighted for three consecutive years by one of these batteries, and this example seems likely to be followed by many other similar installations. Mr. Ross maintains that primary batteries, to be successful, require as much attention to mechanical as to chemical questions, and that in order to be generally applicable to house lighting they must necessarily be so arranged as to give no trouble to servants or other unskilled attendants. For example, he has done away with all clamps and complicated connections, and each zinc and carbon plate can be separately lifted from the battery whenever that is necessary; and, what is still more important, the liquids from all the cells are automatically drawn daily from the battery by an arrangement which involves nothing more than that a servant, or the last clerk in the office at night, is required, when leaving, to move the handle of a switch. On the following day, before the lamps are lighted, the liquid is slightly "refreshed," and the battery refilled by an equally simple process, continuing in this way to work for a month without any other attention. During the discussion at the Society of Telegraph-Engineers on Nov. 7, 1887, which followed the reading of Mr. Perry Nursey's Paper on "Primary Batteries for Illuminating Purposes," Mr. Ross mentioned that his latest improvement consists in placing all the cells of a battery so that they feed themselves continuously from one large vessel containing the solution, to or from which the liquid is supplied or drawn

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off through one single inlet or outlet. When used for the supply of 1,000 or more lamps the residual products from these batteries can be wholly recovered and utilised as valuable commercial products, for which there is a large demand, which greatly reduces the cost of the electric current.

ROTHEN, Dr. Timothée. Born at Bâle in 1830.

After the completion of his scientific and mathematical studies, Dr. Rothen became, at the commencement of 1864, a partner in the firm of Hipps, telegraphic and electric apparatus makers, of Neuchâtel. In 1867 he became Secretary to the Telegraphic Department at Berne, and in 1890 he was promoted to the post of Director of Swiss Telegraphs, and was subsequently appointed Director of the International Telegraph Bureau. In 1881 he was the Swiss Delegate at the International Congress of Electricians, and in 1890 he held a similar position at the Paris International Telegraph Conference. He has written numerous works on telegraphy and telephony, some of which have been published in the *Journal Télégraphique*. In 1886 he was made a Doctor of Philosophy by the University of Berne (*honoris causâ*).

ROWLAND, Prof. Henry A.

The Rev. H. A. Rowland, father of the distinguished son of the same name, and himself a personage of no mean distinction, and of old Connecticut Congregational stock, was a graduate of Yale and Andover, and a pastor in the Presbyterian Church for nearly thirty years. It is evident that the genius of the boy soon found its object and career, and was helped on, for in 1870, when he was barely of age, Prof. Rowland graduated from the Rensselaer Polytechnic Institute at Troy as a civil engineer. The next year found him railroad surveying in Western New York, but his ability as a teacher was already recognised, and his services were called into requisition at Wooster University. In 1872 he returned to Rensselaer as instructor in physics, and in 1874 he became assistant professor. In the meantime he had completed his now widely-known experiments on magnetic permeability, but at first he was unable to get them published. The scientific journals in America rejected his work, but, confident of its value, he sent his results to Clerk Maxwell, who at once had them published in the London *Philosophical Magazine*, and wrote kindly and encouraging letters to the young investigator. He was now becoming known, and when the authorities of the newly-founded Johns Hopkins University, at Baltimore, cast about them for some one to fill the chair of physics and become director of the physical laboratory, Rowland, with his already recognised ability and with the countenance which Maxwell's recognition of his talents gave, was chosen for the place. Prof. Rowland accepted the chair, which he still holds with credit to himself and with great honour to a university that he has since then done so much toward making the great seat of American learning and the true home and sanctuary of science that we all know it to be. This was a year before the University actually opened, and the interval he spent in Europe, working in Berlin with Helmholtz. Here he investigated the effect of static electricity in motion, and proved that a moving charge has the effect of a current. While the energies of Prof. Rowland have been largely devoted to exhaustive researches into the nature and phenomena of electricity and magnetism, his work takes a broad sweep through nearly the whole range of physics. His original work has been extensive, and many of the investigations made under his direction at Johns Hopkins are of world-wide celebrity, such, for example, as his determination, for the Government, of the exact value of the ohm as the standard unit of resistance. To the public his name is probably even more familiar in connection with his large diffraction gratings, which are ruled by a method of his own directly on concave mirrors, the image of the solar spectrum being thus produced without the aid of lenses. In fact, the photographs of the spectrum obtained with the aid of these gratings far exceed anything else of the kind, and their exhibition before the National Academy of Sciences in 1883 was one of the leading scientific events of the year. The well-earned degree of Ph.D was conferred upon Prof. Rowland by the John Hopkins University in 1880. As a member of the Electrical Congress at Paris, in 1881, and of the jury at the Electrical Exhibition at the same time and place, he received the order of a Chevalier of the Legion of Honour. In 1881 he was elected a member of the National Academy of Sciences. In 1883 he presided over the Physics Section of the American Association for the Advancement of Science, at Minneapolis, and read a memorable address, entitled "A Plea for Pure Science." In 1884, being appointed by the Government on the Commission specially formed for the purpose, he presided over the deliberations of the National Conference of Electricians at Philadelphia. In 1884 he received from the American Academy of Arts and Sciences, of which he is an Associate, the Rumford medal for his researches in light and heat; the Draper Medal was also presented to him by the National Academy of Science. He has written and read many Papers on electrical and physical subjects, amongst them the article on "Screws" in the "Encyclopædia Britannica." In addition to developing the resources of the physical and electrical laboratories at Johns Hopkins, where an electrical testing bureau of great promise has also been lately established, Prof. Rowland in some manner continues to devote time to many other matters of importance. His principal work of late years has been in spectrum analysis, and in 1888-89 he published his "Photographic Map of the Normal Solar Spectrum—second series." He is corresponding member for the British Association for the Advancement of Science and of the Cambridge Philosophical Society, a foreign member of the Royal Society, is one of the twelve foreign members of the Physical Society of London, one of the ten foreign members of the Physical Society of Paris, a corresponding

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member of the Institute of France and the Royal Society of Göttingen, and of many other societies. At the Chicago Congress in 1893, he was Chairman of Section A, and was President of the Chamber of Delegates for Defining Electrical Units.

RÜCKER, Arthur William, M.A., F.R.S., M.I.E.E. Born October 23, 1848, elected Mathematical Scholar of Brasenose College, Oxford, in 1867, Junior University Mathematical Scholar in 1869, Fellow of Brasenose College in 1871, and Honorary Fellow in 1891.

Mr. Rücker was Demonstrator in the Clarendon Laboratory of the University of Oxford from 1871 to 1874, when he was appointed Professor of Mathematics and Physics in the then newly-founded Yorkshire College, Leeds. He was elected a Fellow of the Royal Society in 1884, has since served upon the Council, and was awarded a Royal Medal in 1891. Mr. Rücker resigned his Professorship in the Yorkshire College in 1885. He was a candidate for North Leeds in the General Parliamentary Election of that year, and for the Pudsey Division of Yorkshire in 1886. Prof. Rücker was appointed in 1886 to fill the Chair of Physics at South Kensington, vacated by the death of Prof. Guthrie, and is President of the Physical Society of London, Treasurer of the British Association, and a Fellow of the University of London. He is the author or joint author of various scientific Papers, of which several on the electrical properties of thin liquid films were published in conjunction with Prof. Reinold, F.R.S., in the *Proceedings* of the Royal Society for 1877, in the *Philosophical Transactions* of the Royal Society for 1881, 1883, 1886, and 1893, and in the *Phil. Mag.*, Feb., 1885. He has also written on the Self-Regulation of the Compound Dynamo (*Phil. Mag.*, June, 1885); on the Dimensions of the Electrostatic and Electromagnetic Units (*Phil. Mag.*, Feb., 1889); and, in conjunction with Mr. C. V. Boys, on the "Optical Demonstration of Electrical Stress" (*Proc.* Soc. Tel. Eng., Vol. XVII., 1888). Together with Prof. Thorpe, F.R.S., Prof. Rücker has made the first complete magnetic survey of the British Isles, the magnetic elements having been determined by them at more than 200 stations. The results of the survey, including a discussion of the relations between the geological conformation of various districts and the local magnetic disturbances which occur in them, were presented to the Royal Society in the Bakerian Lecture for 1889. Since that date the work of the Survey has been very much extended, a portion of the Government Grant Fund having been allotted in the years 1890-92 to Profs. Rücker and Thorpe to enable them to carry on the work of observing and computing by the aid of assistants.

RYAN, Harris Joseph, M.E. Born in Pennsylvania in 1866. Educated at Baltimore City College, Lebanon Valley College, and Sibley College, Cornell University.

Prof. Ryan received his degree of Mechanical Engineer at Cornell University in 1887. He engaged in business as constructing engineer during 1887 and 1888. In the fall of 1888 he accepted an appointment as Instructor in Physics, being detailed to the work of applied electricity in Cornell University. Since 1889 he has served as Associate Professor of Electrical Engineering in the Sibley College, Cornell University.

Prof. Harris Ryan is a Fellow of the American Association for the Advancement of Science and an Associate Member of the American Institute of Electrical Engineers before which he has read several Papers. His scientific work and investigations are mainly along practical lines. His speciality is the design and construction of electrical machinery. He has devoted much time and energy to the investigation of armature reactive effects and phenomena affecting dynamo regulation. He has applied and investigated the method of balancing armature reactive effects by a pole face winding in series with the armature. Prof. Ryan was an active member of the Board of Judges of Awards at the Chicago Exhibition in 1893.

RYAN, John, M.A. and LL.M. (Cambridge), D.Sc. (London). Born in Newport (Monmouthshire) 1858; educated at Ratcliff College, Owens College, and King's College, Cambridge.

Dr. Ryan studied at Owens College in 1877, having obtained the third Whitworth Scholarship in Engineering. He resigned the Whitworth Scholarship and obtained in 1878 the Clothworkers' Exhibition for Natural Science, tenable at Oxford or Cambridge. He entered Cambridge in 1878 as a non-collegiate student. He resigned the Exhibition in 1880 and entered King's College, Cambridge. In the same year he was successively elected to the Vintner Exhibition and to the first Foundation Scholarship awarded for Natural Science at King's College. He passed his first B.Sc. in the London University in 1880, being placed first on the Honours list in Experimental Physics, and qualifying for the Arnott medal. In 1882 he graduated as Bachelor of Science at London, being placed in the First Class in Honours in Experimental Physics and also in Geology. In 1883 he obtained the degree of Doctor of Science, qualifying in Electricity. He graduated at Cambridge in 1881 in the Mathematical Tripos, and in 1882 and 1883 he obtained First-class Honours in the two parts of the Natural Science Tripos.

In 1883 Prof. John Ryan was appointed Superintendent of the Technical Schools, then being started at the University College, Nottingham. In 1884 Dr. Ryan was appointed Professor of Mechanics and Engineering in the University College, Nottingham. In 1885, on two vacancies occurring at the University College, Bristol, he was elected to succeed Prof. Silvanus Thompson in the Chair of Physics, and Prof. Hele Shaw in the Chair of Engineering. Since that year he has been chiefly engaged in developing the work of these departments. In 1888 he graduated as Master of Laws in the Law Tripos at Cambridge, and was called to the Bar at the Inner Temple in 1891.

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SAHULKA, John. Born in Deutsch-Wagram, near Vienna, in 1857.

Mr. Sahulka was educated at the University in Vienna. He passed the examinations as Professor of Mathematics and Physics in 1882; in the same year he graduated as Doctor of Science. He taught mathematics and natural philosophy in the middle schools of Vienna from 1882-88, was then prefect at the Theresian Akademie in Vienna, then assistant for natural philosophy and electrotechnology at the High Technical School in Prague from 1889-91; since that time he has been occupied at the Technische Hochschule in Vienna as docent of electrotechnology and assistant of Prof. von Waltenhofen. He has published several Papers in the Kaiserliche Akademie der Wissenschaften in Vienna, and in the *Elektrotechnische Zeitschrift*, *Zeitschrift für Elektrotechnik*, and *Annalen der Physik und Chemie*.

SALOMONS, Sir David L., Bart. Born in 1851, on the anniversary of the Queen's coronation.

Sir David was educated partly by private tuition and afterwards at Caius College, Cambridge, graduating in the Natural Science Tripos, as the innate bent of his mind tended more to physical science than to pure mathematics. Not content with mere theoretical knowledge, he was in the habit of frequenting workshops, working with the men, and thus gaining a thoroughly practical insight into mechanical work; his uncle, moreover, provided him with a laboratory, where he could devote his attention to the subjects which interested him so deeply. He belongs to many societies, being an Associate of the Institution of Civil Engineers, a Fellow of the Royal Astronomical Society, of the Chemical Society, and of the Geological Society, and a Vice-President of the Institution of Electrical Engineers. His workshop is a large room and two small rooms full of machinery. There are machines for drilling, milling, shearing, sawing, grinding, planing, and there are lathes of different dimensions, with apparatus complete; indeed, every description of general work can be executed either in wood or metal, from the most delicate scientific instrument, whether clockwork or electric apparatus, to the roughest possible work. The whole of this machinery is driven by a number of electric motors. To the right there is a laboratory and room for photographic processes, at which Sir David is an adept and an inventor, for he introduced and exhibited at the International Exhibition of 1873 his nitro-ammonia process. He also invented an electric exposing camera in 1870, besides many electrical and mechanical improvements for railway signalling and electric improvements, and many are used with success. He was awarded a silver medal at the Inventions Exhibition, and a gold medal and diploma at the Birmingham Exhibition, 1889. Outside the workshop is a large building containing two complete installations for 500 16 candle-power electric incandescent lamps, so that each set of engines, boilers, &c., are in duplicate, with an accumulator room adjoining. Many novel devices are used with success, and no breakdown has occurred since its completion (March, 1883). There is also a powerful arc lamp on the observatory tower close by, and two small arc lamps for photography at night. All the additions to the house, as well as to the new buildings, &c., were designed and carried out by Sir David. He has written a number of Papers and pamphlets on various electrical and other matters, also books on "Electric Light Installations and the Management of Accumulators" (regarded as a text-book on the subject) and on "Photographic Notes and Formulæ." Sir David was High-Sheriff for Kent 1880-81; is a magistrate for Kent, Sussex, Middlesex, Westminster and London; is a D.L. for Kent; is a County Councillor for Kent, and was called to the Bar in 1874.

SANKEY, Henry Riall, Captain Royal Engineers. Born at Nenagh, co. Tipperary, in 1853. Educated principally in Switzerland, at Mr. Rippin's School, Woolwich, and at the Royal Military Academy, Woolwich.

He entered the Royal Military Academy in 1872 at the head of the list, a position he retained, and passed out in 1873 with honours, obtaining a commission in the Royal Engineers. He also received the Pollock Gold Medal as the most distinguished cadet of his term, the sword for exemplary conduct, the mathematical and other prizes. He distinguished himself during the course of instruction at the School of Military Engineering, Chatham, receiving the Fowke Medal for Building Construction, and was also selected to assist at the Railway Brake trials carried out in 1874 by the Royal Commission on Railway Accidents. After serving at the War Office and at Manchester he was ordered to Gibraltar, where, amongst other things, he had charge of the Military Telegraphs. In 1879 he went to Canada as Instructor in Military Engineering at the Royal Military College of Canada, Kingston, Ontario, where he published some notes on "The Use of Explosives and the Electrical Testing connected therewith." In 1882 he was ordered to Southampton to do duty on the Ordnance Survey, and was placed in charge of the stores, workshops, and electrical arrangements. He then carried out some successful experiments in depositing copper with a dynamo in connection with the reproduction by the electrotype process of the engraved copper-plate Ordnance Survey Maps, and read a Paper thereon before the Society of Telegraph-Engineers and Electricians, for which he was awarded the Fahie premium, and he also received the Paris premium the next year for another Paper on "The Deposition of Copper." Under his direction a considerable quantity of all kinds of machinery was laid down at the Ordnance Office, Southampton. In conjunction with Colonel Bolland, R.E., he has patented a new electrotype method of producing mezzotint engravings, and, in connection with Mr. P. W. Willans, an improved combination of a dynamo and engine. He has also made improvements in photogravure, and has translated Prof. Ritter's book, "Iron Bridges and Roofs," from the German. In 1889 Captain Sankey

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quitted the Royal Engineers, and became a Director of Willans and Robinson, Limited, of Thames Ditton.

SCHUCKERT, Sigmund. Born at Nuremberg, 1846.

After receiving general instruction in his native town, Schuckert spent five years in various workshops in Stuttgart, Hanover, Hamburg, and Berlin, and then went to America, being employed at New York, Baltimore, Cincinnati, and Newark. In the year 1873 he returned to Germany, started a small workshop in Nuremberg, and constructed a dynamo-electric machine for electro-depositing work, known as the Flat-Ring type. He obtained a number of patents for the division of the armature current into two circuits, one of which excited the field-magnets. Other patents are:—1877, for a dynamometer; 1879, for overhead railway conductors. In 1880 he commenced manufacturing the Piette-Krizik lamp (known in England as the Pilsen lamp). After transforming his business into a Kommanditgesellschaft (limited liability company), Herr Schuckert was engaged in the construction of central stations at Barmen, Lübeck, Hamburg, Bremen, Hanover, Düsseldorf, Aachen, Altona, Christiania, Naples, Verona, &c. In 1888 the novel light projector for military and naval purposes was brought out, known as the Schuckert-Munker projector (patented also in this country), with parabolic mirrors made by a special grinding machine, and which has attracted so much attention all over the world. In April, 1893, the Company became the Elektrizitäts-Aktiengesellschaft vormals Schuckert and Co.

SELLON, John Scudamore.

Mr. J. S. Sellon has been for upwards of thirty years an active member of the well-known firm of Johnson and Matthey of London, assayers and metallurgists, and his name has for that period been associated with those of the leading scientific men of the day in matters relating to metallurgy, chemistry, and the arts and sciences generally. Quite early in the history of electric lighting Mr. Sellon interested himself *con amore* in its development, and became a devotee to the cause, and he has been a consistent advocate of its advantages and a sturdy champion for its rights from the early days. As an inventor Mr. Sellon's name stands out somewhat prominently. His many patents in connection with secondary batteries and their manipulation are amongst the earliest and the most important in that line, and have never been successfully challenged. His first patents under this head were taken out in 1881, and in that year his residence at Sydenham was fitted up throughout with the electric light, the lamps being run from accumulators; this, we believe, was the first private house in the world which was so lighted in its entirety. Mr. Sellon was, until its amalgamation with the Electric Construction Corporation in 1889, vice-chairman of the Electrical Power Storage Company, which worked his patents in conjunction with those of Faure, Swan, and others. He was for ten years (from its first initiation) vice-chairman of the Anglo-American Brush Electric Light Corporation (now known as the Brush Electrical Engineering Company), and, as is evidenced by his public statements and private work, has never wavered in his faith as to the great ultimate success of that important undertaking, which at this time seems fully assured.

SHALLENBERGER, Oliver J. B. Born May 7, 1860.

Mr. Shallenberger entered the United States Naval Academy as a cadet engineer in 1877, where he made a special study of subjects bearing on the practical applications of electricity, and experimented in the construction of incandescent lamps. He graduated in 1881, and was assigned duty on the European station. On his return in 1883 he resigned his position to pursue electrical work. He became connected with the Union Switch and Signal Company of Pittsburg in 1884, and then, soon after the organisation of the Westinghouse Electric Company, he became its chief electrician, which position he has held ever since. During this time Mr. Shallenberger has patented a number of inventions relating principally to the use of alternating currents, of which perhaps the best known is his alternating-current meter.

SHELDON, Samuel, A.M., Ph.D. Was born in Middlebury, Vt., on March 8, 1862. He entered Middlebury College and graduated with the class of 1883, as its salutatorian.

Dr. Sheldon held the position of Instructor in Mathematics in Middlebury College during the academic year 1884-1885. He entered the University of Wuerzburg, Germany, in 1885, and was appointed assistant in Physics the following year, which position he held until Easter, 1888, when he received the degree of Ph.D. Returning to America, he was appointed assistant in Physics at Harvard University. He held this position for one year, when he was called to the chair of Physics and Electrical Engineering at the Polytechnic Institute of Brooklyn, N.Y., which he still retains. He is a member of the American Institute of Electrical Engineers. He is past vice-president of the department of Electricity and present president of the department of Physics of the Brooklyn Institute of Arts and Sciences. He is the author of "Chapters on Electricity," and was the revising editor of the fourth edition of "Olmsted's College Philosophy"; and he has published many articles in the leading American scientific publications of the day.

SIEMENS, Alexander. Born at Hanover in 1847, and educated at the Lyceum and the Polytechnic College there, and at the University, Berlin.

Mr. Siemens came to England in 1867, and worked for a short time at the telegraph factory of Messrs. Siemens Brothers at Woolwich. He went to Berlin in the following year to study at the University, and remained there until 1870, with the exception of fulfilling a tempor-

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ary engagement, during which he assisted in constructing the Indo-European telegraph line from the Persian frontier to Teheran and in laying the Black Sea cables at Kertch and from Sukhum Kale to Sotcha. He was next called upon to serve his country in the Franco-German war, and was present at the siege of Metz, and afterwards, under Prince Frederick Charles, joined in the operations against Orleans. He was wounded at the battle of Beaune la Rolande, and for his distinguished services in the field received the Iron Cross, a distinction conferring great honour upon the recipient. At the conclusion of the war, Mr. Siemens was again able to continue his scientific studies, and came to England, and became a pupil of the late Sir William Siemens. In 1873-4 he was conducting experiments for Sir William at Birmingham, with a rotary furnace to produce wrought iron and steel direct from the ore. On one occasion this furnace was used to cremate a pig in the presence of Sir Henry Thompson, to demonstrate the feasibility of using such furnaces for cremation. In 1875 Mr. Siemens joined the cable ship "Faraday," belonging to Sir William's firm, and took part in several cable laying and repairing expeditions. Whilst the ship was stationed at Halifax, N.S., he built some blast furnaces at Londonderry, N.S., for the Steel Company of Canada, and superintended the erection of a rotary furnace at Pittsburg, Pa., U.S.A. Returning to England in 1877 he was employed in erecting regenerative gas furnaces for various purposes in different parts of England for Sir William Siemens, among them being the first continuous working tank glass furnace erected in this country. In 1879 he became actively engaged in electrical work for Messrs. Siemens Brothers, and amongst the first electric light installations made were those at the Albert Hall, the British Museum, the Albert Docks, and the Blackpool Promenade. He also installed the electric light at Godalming, the first town in England to so light all its thoroughfares, and supply current to private consumers. Mr. Alexander Siemens became a Director of Siemens Brothers and Co., Limited, some time ago, and is now the only director residing permanently in England. In 1892 he contributed a Paper to Section G of the British Association at Edinburgh on "Electric Locomotives on the City and South London Railway." He has been for many years a member of the Institution of Electrical Engineers, to which body he has contributed several Papers of great interest to the profession, the most recent being that read on February 11, 1892, upon "Some Experimental Investigations of Alternate Currents."

Mr. Siemens was elected a Vice-President five years ago, and is the President of the Institution for 1894.

SIEMENS, Carl, M.I.C.E., M.I.E.E.
Born at Menzendorf, in Mecklenburg, in 1829. His brothers owe much to him for the energy with which he has helped to further the extension and practical application of their inventions, more especially in Russia. Since 1854 Messrs. Siemens have had at St. Petersburg a large manufactory for telegraph apparatus, dynamos, &c., which business has, with an interval of eleven years, when he assisted in directing the firm in London, been conducted by him. The network of telegraph lines which covers Russia was laid by Mr. Carl Siemens for the Russian Government. The firm also established pottery works for the purpose of making the well-known china insulating cups for telegraph posts, whilst in the Caucasus the brothers, Werner and Carl, possess copper works and oil springs. Mr. Carl Siemens was personally in charge of the laying of the Direct United States cable, the first Transatlantic cable contracted for by the firm of Siemens Brothers. He is at present director of the company of Siemens Brothers and Co., Limited, partner in the firm of Siemens and Halske, of Berlin and of St. Petersburg, president of the Russian Electric Light Company, and president of the St. Petersburg Joint-Stock Bank. He has received Orders from various countries in acknowledgment of his great services.

SIEMENS, Frederick. Born in 1825 at Menzenderf, a large property rented by his father, near Lübeck.

Mr. Siemens was educated at the Gymnasium of Lübeck up to his sixteenth year, when a desire for liberty urged him to go to sea as a sailor. After a few years he gave up a seafaring life, and came to England in 1848 to introduce his brother's (Dr. Werner Siemens) telegraphic apparatus. Owing to the monopoly of electric telegraphy then possessed by Messrs. Wheatstone and Cooke he was not very successful, and took to practical engineering with his brother William (the late Sir William Siemens), who had lately applied the regenerative principle to steam-engines. Mr. F. Siemens succeeded in applying it to furnaces, in combination with gaseous fuel, whereby a great saving has been effected in fuel, and very high temperature produced. His regenerative gas furnace has made possible the production of open-hearth steel, and of glass melting by the continuous process in tanks. Mr. Siemens is also the inventor of the regenerative gas burner and stove, the former of which gives out a brilliant light, and the latter an intense heat, these effects being produced with a saving of two-thirds the gas formerly used. He has also brought out many inventions connected with the glass industry, and possesses four factories in Saxony and Bohemia, employing over 4,000 men. While his principal achievements are to be found in the fields of invention and industry, he has likewise distinguished himself in scientific research, and has given Papers and lectures before scientific societies in this country. Among them may be mentioned those on "Heating by Radiation," "Distributing Light and Heat," "Tempering Glass," "Dissociation," and "Combustion," all of which he has treated both from the theoretical and practical points of view.

SINCLAIR, Dane. Born in Caithness, June 6, 1852.
Mr. Sinclair's first connection with telegraphy

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was in the engineering branch of the telegraph department of the North British Railway, which he joined in 1872. In 1875 he was selected to proceed to Japan in the service of the Japanese Government as Inspector of Telegraphs, and remained there for five years. His experience in the construction, maintenance and working of telegraphs in that country prepared him for the varied experience which he has had since his return from that country in 1879. He then joined the Dundee and Arbroath Joint Railway in charge of the telegraph and stores department, where he took out his first invention, this being a patent for waggon cover fasteners, which effected an enormous saving in railway stores. In 1882 he was appointed Engineer to the National Telephone Company for the Glasgow District, and shortly afterwards became electrician to the Company in addition. While in Glasgow he invented several appliances for telephone service, some of which have come into general use. Among these may be mentioned the single cord switchboard, now so largely used throughout the country; the automatic switchboard system, described in Preece and Maier's Book of Telephony; the automatic call box; Sinclair's patent solder, in which the resin is contained in a tube of solder; a ring-off system for exchanges; a horizontal multiple switchboard, &c., &c. On the amalgamation of the three principal telephone companies in the country, he was selected by the Directors of the newly-amalgamated Company to examine and fully report on the entire telephone system and management of the metropolis; and on the basis of this report the reorganisation of the system was carried out, Mr. Sinclair being appointed to the important position of London Manager, and in June, 1892, he was promoted to the responsible position of Engineer and Electrician-in-Chief over the entire system of the National Telephone Company, which he continues to hold. He is a Member of the Institution of Electrical Engineers. He has written several Papers for the Glasgow Philosophical Society, of which he was a member of the Council, and has published in *The Electrician* a series of Papers on improvements in telephony in Scotland.

SNELL, Albion T. Born August 2, 1858.

Mr. Snell comes of a Devonshire family, and was educated at St. Clement Danes Grammar School and King's College, London. At the latter, in the Applied Science Department, under Prof. Grylls Adams, he studied civil and electrical engineering, worked in the Wheatstone Laboratory, and experimented in physics, mechanics, chemistry, and electricity. He also attended the City and Guilds Technical College; and there, under Profs. Ayrton and Perry, made an elaborate course of experiments with dynamos. Among others, he has held the appointment of assistant to Mr. J. Swinburne on the staff of the late Hammond Company. There, in conjunction with his chief, he carried out some most important work in connection with electrical measuring instruments, accumulators, motors, and dynamos, and more especially in relation to the designing of motors and dynamos for constant E.M.F., current and speed, &c. In the year 1885 he joined Messrs. Immisch and Co., and at the Inventions Exhibition he represented that firm, which succeeded in obtaining the Silver Medal for improvements in motors. During the year he was appointed electrical engineer to the same firm; and at once vigorously attacked the question of transmission of power by electricity. As early as 1886 he had completed the design of the present standard type of the well-known "Immisch" motor, and before the expiration of that year had successfully installed it for a variety of purposes. About this time he studied the application of electricity to mining work; and in 1887 designed and worked a 70-H.P. pumping plant at St. John's Colliery, Normanton, which was then the largest transmission plant in the United Kingdom. This was soon followed by other plants of a similar character, suited to the various requirements incidental to mining. In many respects he may be regarded as the pioneer of electrical mining work. He has also given his attention to tramcar and launch work. On the absorption of Messrs. Immisch and Company by the General Electric Power and Traction Company in May, 1890, he was appointed chief engineer to the new Company. His command included the whole of the general business of the Company, and the mining, tramcar, and launch departments. The electric trams on the section of the North Metropolitan Tramway Company at Barking received his immediate attention, and he designed new motors with positive gearing, on self-contained frames, especially for them. He also attacked the general problem of accumulator cars, building steel under-frames and special motor-trucks to stand the increased weight. In May, 1892, he severed his connection with the General Electric Power and Traction Company, and is now practising as a consulting engineer in London and Sheffield. During the last two years he has given special attention to alternate-current —single and multiphase—working; in connection with which he read a paper before the Institution of Electrical Engineers, entitled, "The Transmission and Distribution of Power by Alternate Currents," in the spring of 1893; and also one at the British Association meeting at Nottingham on "The Utilisation of Waste Water Power by Electricity." He is engaged in writing a book for *The Electrician* Series, to be entitled, "Electric Motive Power," which is designed to be a *vade-mecum* for users of electric power plant. Mr. Snell is well known in connection with the literature of dynamo and motor design and the application of electricity to mining work. He is an Associate Member of the Institution of Civil Engineers, Member of the Institution of Electrical Engineers, and Member of the Federated Mining Institute of England.

SPAGNOLETTI, Charles Ernest Paolo della Diana, was born 1832, at Brompton; and was educated at Blemmell House, Brompton. Mr. Spagnoletti is a descendant of the illustrious and noble family of the

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ALBION T. SNELL.

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Dianas of Sicily and Italy. The name of Spagnoletti was given by popular voice to his grandfather Paolo della Diana, which he adopted. He came to this country about 1798.

On commencing active life, in 1846, Mr. Spagnoletti was engaged for a short time in the Actuary's Department of the National Debt Office, and afterwards took an appointment under Mr. Alexander Bain, the inventor of the chemical printing telegraph, with whom he worked, and assisted in carrying out many early experiments in the development of this system of telegraphy, until the Electric Telegraph Company opened their central station at Founder's Court, Lothbury, in January, 1847, when he commenced his service with that company, representing them in several towns in England until he entered the service of the Great Western Railway Company, in 1855, as chief of the telegraph department, where he at once began to organise a system, drawing out a book of rules and special codes to meet the requirements of railway working, which laid the foundation of the regulations now in use on every line in the kingdom, and he has been aptly termed "Father of Railway Telegraphy." When the Metropolitan Railway in 1865 was opened, it was worked by the Great Western Railway, and in order to meet the requirements of an anticipated heavy traffic and quick succession of trains Mr. Spagnoletti brought out, in 1865, his disc block instrument for controlling the traffic of this line, and drew out the regulations therefor. On the opening of the District Railway the same system was adopted, and he constructed the telegraphs for both these lines. His block system is also in use upon the Great Western Railway and some other railways at home and abroad. He also arranged this instrument to work on the 1, 2, and 3 wire systems. Finding the effects of lightning were exceedingly dangerous to the working of the block system, by weakening, neutralising, and reversing the signals, he next invented his induced coil, which entirely removed these dangerous results; and this invention is now generally used in all needle instruments, its advantages being so manifest that the Government and all railway companies using needle instruments have adopted it. Keeping his attention to improvements in railway working by electrical appliances, he introduced an instrument to indicate to signalmen the position of the "semaphore arm" when from any cause it is out of the sight of the signalman working it, and also an apparatus for showing whether the signal lamp is "in" and burning properly or "out" at such signals. He also designed, in the year 1868, a large telegraph board for Ascot race course, showing the starters and winners of the races. This is electrically worked from the weighing room and judge's box, about half a mile distant. This at the time was the largest piece of electrical machinery ever made, and was designed at the request of the Earl of Cork and Orrery, Master of the Buckhounds, with a view of dividing the crowd, which was yearly increasing, as the rush to obtain the numbers was getting serious. Mr. Spagnoletti has also patented many improvements, such as electrical signals, electrical appliances for working railway drawbridges over rivers and docks, so that no train can be signalled and allowed to pass over it until these bridges are in proper position; locking block instruments of various kinds; also a system for electrically locking the signal and point levers, so that the signalman at the station in advance may control (as regards sending trains forward) the working of the signals at the station in the rear; and for controlling immediate sidings, drawbridges, &c., and adding to the safety of railway travelling both on double and single lines, the trains by this system performing part of the working themselves, controlling and checking the signalman at each end of the section, which system is used on several lines of railways; a system of various fire alarms for towns, districts in large cities, and for lunatic asylums and other large establishments; also an electric bell, by which any number can be worked and kept ringing on a single line wire; an electric tell-tale clock for asylums, by which a record is made of every visit paid throughout the night to each room or particular spot appointed, showing the duration of each visit, and the time occupied in getting from one room to the other. This clock is also applicable to railway signals, so that the exact time a signal arm is either at "danger" or "all right" is recorded, and the register can at any time be examined. In the year 1873 he brought out a polarised relay; and in 1881 patented a dynamo electric machine and a system of communication between passengers and guards; also an electric motor and an arrangement for protecting trains in station-yards while shunting and standing on the wrong lines; also a system for railways worked by electricity, for controlling approaching trains from the signalman's cabin at the station in advance in connection with the electric locking of signals, so that the "current" is "cut off" from the charging rail or conductor of the signals and put to danger to stop a train, or, in case of emergency, the signalman can, if it is necessary, stop an approaching train by depriving it of its power of motion. In 1889 he was appointed consulting electrical engineer for the City and South London Railway (the first electrical railway), and advised as to the mode of working this line and in drawing out the specification for the mechanical and electrical plant, for powers, &c., &c. Mr. Spagnoletti was President of the Society of Telegraph-Engineers and Electricians for 1885; he is a Fellow of the Imperial Institute, a member of the Institution of Civil Engineers, of the Society of Arts, of the Physical Society, and of other institutions. He was a juror of the Paris Exhibition in 1878 for the Electrical Department, and member of the Congress and exhibitor at the Electrical Exhibition of Paris, 1881, and received a silver medal; also juror and exhibitor at the Crystal Palace, 1882, and on the General Committee and juror of the Electric Lighting Department of the International Health Exhibition of 1884, and the Inventions Exhibition, 1886. He was for thirty-seven years chief electrician and telegraph-engineer of the Great Western

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Railway, and is now consulting electrical engineer to that Company. He is also managing director of the Phonopore Company, Limited.

SPRAGUE, Frank J. Born at Milford, Connecticut, U.S.A., on July 25, 1857.

Mr. Sprague spent most of his boyhood in circumstances not by any means too affluent, at North Adams, Massachusetts. Early in 1874, a notice being published in the Boston papers of a competitive examination for candidates for appointment at the Annapolis Naval Academy, he made up his mind to seize the chance. He was successful, and, borrowing the money needful to give him a fair start, he entered the Academy that year. He finished a four years' course in 1878, graduating seventh in a large class. Early in 1880 Mr. Sprague was promoted, and enjoyed much-prized opportunities for electrical work at the Stevens Institute, Hoboken, and at the Newport torpedo station. While at Newport he had the benefit of meeting and exchanging ideas with that Nestor of American electricity, Moses G. Farmer. In 1881 he was sent off to the Mediterranean on board the U.S. s.s. "Lancaster," and in 1882 he was detailed to the Crystal Palace Electrical Exhibition to report for the Government. He was made a member of the jury, being the only American on it, and was also made secretary of his section. His report to the Navy Department was an excellent piece of work in every way, and being now quite rare, is highly valued by all who have copies of it. It need hardly be said that the Exhibition afforded him many opportunities that were eagerly caught at for renewed experiment, especially in the field of electrical power, which he had convinced himself was the next great outgrowth of practical electricity. He had also made the acquaintance of progressive men of like tastes and ideas with himself, among whom may be specially mentioned Mr. E. H. Johnson, at whose invitation, in 1884, he joined the Edison ranks. Coming directly in contact with practical work in this way, Mr. Sprague was confirmed more than ever in his belief as to the possibilities of the electrical transmission of power, and he resolved to devote himself entirely to the problems awaiting solution in that field. Mr. E. H. Johnson encouraged him, and being thus enabled to put his ideas and inventions in form, Mr. Sprague went to the Philadelphia Electrical Exhibition with several motors bearing his name. The result was as might have been expected. The work done by the motors, and the ingenious principles involved, created so favourable an impression that the formation of the Sprague Electric Railway and Motor Company was a matter of course, and, in fact, the company was barely formed before it was overwhelmed with business. Since that time the industry thus started has grown wonderfully, and, thanks largely to the genius of Mr. Sprague, as well as the steadiness and foresight with which he has been accorded support, difficulties that once seemed insuperable, whether in stationary work or the operation of street railways, have been triumphantly overcome. All this work has been done in but a few years, and it is no small honour for such a young man as Mr. Sprague that his part in the great revolution has been so prominent. Without deep-seated confidence in himself Mr. Sprague would never have grappled with some of his undertakings, such, for example, as the now celebrated road at Richmond, Virginia, the attempt to operate which was looked upon by several of his friends as sheer madness, but which embodied many of the features and devices that have already become standard and essential to success. While it is true that Mr. Sprague's hard-won reputation rests very largely upon his achievements in the domain of electrical power, it is worthy of note that other subjects have received his attention, and that he has made inventions in other fields.

STALLIBRASS, Edward. Born at Eastwoodbury, Essex, 1862. Educated at Nassau School, Barnes.

Mr. Stallibrass began his career in 1881, becoming articled to the late Sir Charles T. Bright, M.I.C.E. During the Electrical Exhibition of Paris in 1881, he assisted Sir Charles, who was a Commissioner for Great Britain, and subsequently studied at King's College, London, under Prof. Adams, F.R.S. Adopting submarine cable work as his particular branch of engineering, he joined the staff of the India Rubber, Gutta Percha, and Telegraph Works Company, and whilst with them assisted in the manufacture and laying of the following submarine cables: Central and South America Telegraph Company's cables, between Tehuantepec, La Libertad, San Juan del Sur, Panama, Pearl Islands, Buenaventura, St. Helena, Payta, and Chorillos; the Spanish National Telegraph Company's cables, between Cadiz, Teneriffe, Grand Canaria, La Palma, St. Louis, and Dakar; the African Direct Telegraph Company's cables, between the Cape Verde Islands and Bathurst, and between St. Paul de Loanda, Benguela, and Mossamedes; the West African Telegraph Company's cables, between Dakar, Bathurst, Bulama, Bissao, Konakry, Sierra Leone, Accra, Grand Bassam, Porto Novo, São Thomé, Principe, Gaboon, and St. Paul de Loanda, and between Bonny and Principe; Lloyd's Tory Island cable. He assisted on board the "International" during her survey of the North Atlantic bed, between Spain and the Canaries, and on the "Buccaneer" during her sounding work off the Coast of Africa, from Sierra Leone to St. Paul de Loanda, under the direction of Mr. J. Y. Buchanan, F.R.S. He has also been out on numerous repairing expeditions. In 1890, he accepted an appointment offered him by Mr. W. Sharpey Seaton, and has since been actively engaged in the carrying out of his contract for the laying of some 2,500 miles of cable for the Société Générale des Téléphones of Paris, between the following places in the West Indies: Puerto Plata, Martinique, Surinam, Cayenne, Vizeo; as well as between Port au Prince and Mole St. Nicholas, and Fort de France and St. Pierre. He became a Student of the Institution of Electrical Engineers in 1882, an Asso-

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ciate in 1885, and a Member in 1887. He was a Student at the Institution of Civil Engineers in 1882, and in 1883 was elected an Associate Member. He is also a Fellow of the Royal Geographical Society, and has contributed to their Magazine. He read a Paper before the Institution of Electrical Engineers, in 1887, on "Deep Sea Sounding in connection with Submarine Telegraphy," which was awarded the Fahie premium. He is the inventor of a new form of detacher for deep sea sounding sinkers, and of an improved grapnel for submarine cables.

STATTER, John Grice. Born 1852 at Wakefield.

Mr. Statter is the fifth son of W. Statter, F.R.C.S., and was educated at the Grammar School, Wakefield, and at Sandringham School, Southport, and afterwards at the Yorkshire College, where he studied electricity, physics, and engineering, and worked for a short time at the Physical Laboratory under Prof. Rücker. He took first prizes for engineering field work, engineering construction, mechanism and machinery, and for electricity, and was second in physics. In 1882 he turned his attention to practical work, took out a patent for an arc lamp and other apparatus connected with electric lighting, and started an installation of arc and incandescent lights at his father's house, The Old Hall, Snapethorpe, near Wakefield, using a Robey undertype engine and a Crompton "C" Bürgin dynamo. The lamps used were Swan's, and were in three groups of seven each, placed in series with two arc lamps, one of which was employed to light a tennis court. In the summer of 1883 he entered the works of Messrs. R. E. Crompton and Co. as a pupil. In the autumn of 1885 he commenced business with Mr. S. L. Brunton, at Middleton-road, Dalston. Towards the end of 1886, finding the premises at Middleton-road too small, they removed to the Alliance Engineering Works, at West Drayton, near London. Subsequently he became managing director of Messrs. J. G. Statter and Co., Limited; and upon the amalgamation of this firm with their London agents, the United Electrical Engineering Company, Limited, he became joint managing director of the amalgamated businesses carried on as The Electrical Engineering Corporation, Limited, of Princes-mansions, 68, Victoria-street, Westminster, and Alliance Engineering Works, West Drayton, Mr. Edward Manville being his co-managing director. Mr. Statter is now a partner in the firm of J. G. Statter and Co., Limited, carrying on business as electrical engineers at Princes-mansions, 68, Victoria-street, London, S.W.

STEARN, Charles Henry. Born in Jamaica 1844; educated at the Islington College. Entered the Bank of England, London, in 1862; was appointed to their Liverpool Branch in 1864. Matriculated at the University of London in 1865.

While in the service of the Bank of England Mr. Stearn devoted the whole of his leisure time to the pursuit of physical science. He became a member of the Council of the Literary and Philosophical Society of Liverpool, in whose work he took an active part, and contributed several Papers to their *Proceedings*. He was one of the founders and the first secretary of the Microscopical Society of Liverpool. In 1872 he commenced (in conjunction with Mr. G. H. Lee) a series of researches on the variations caused in the spectra of incandescent gases by changes of pressure and temperature, and communicated a short Paper on the subject to the *Proceedings* of the Royal Society. In the course of this investigation he gained the experience of the precautions necessary to be observed in the production of extremely refined vacua, as well as the influence of the surface impurities of the containing glass vessel on reducing the degree of exhaustion, which was afterwards so valuable in its application to incandescent lamps.

In 1877 Mr. Stearn exhibited before the British Association at Plymouth a portable form of Sprengel pump, in which the bulk of the air was removed by a mechanical pump, and the fall tubes of the Sprengel being in connection with a partially exhausted receiver, the length of the fall tubes was reduced to a few inches. In November of the same year Mr. J. W. Swan, of Newcastle, first made Mr. Stearn's acquaintance, and being familiar with his skill as an experimenter in the production of high vacua, proposed to him to enter on a joint research having for its object the solution of the problem of domestic electric lighting by means of the incandescence of thin carbon conductors in vacuo. Mr. Swan produced at this time some of the thin strips of carbonised paper which had been used by him in his former experiments some twenty years previously. The first lamp was constructed by Mr. Stearn at his residence at Rock Ferry, near Liverpool, in November, 1877, and from that time the research was continued at intervals till the publication of the results in September, 1880, the carbons being prepared by Mr. Swan in Newcastle, and the rest of the investigation conducted by Mr. Stearn at Rock Ferry, the results and suggestions being communicated by the *collaborateurs* to each other by letter. After the successful result of the experiments a larger laboratory was fitted up in the house adjoining Mr. Stearn's, and the foundations of a commercial manufacture were laid by training a few operators and devising the necessary apparatus. After the publication of the results and the exhibition of the new incandescent lamps in Newcastle and London, a company was formed, under the chairmanship of Mr. J. S. Stevenson, M.P., for the commercial exploitation of the invention, and Mr. Stearn at once entered on the task of organising the manufacture at Newcastle, having been appointed general technical manager. Shortly afterwards he superintended the establishment of another factory in Paris for the firm of J. Wilson Swan and Co., in which he had become a partner. On the formation of the Swan United Electric Light Company in London in 1882, the English and Continental businesses in Swan lamps became united, and

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Mr. Stearn was appointed general manager of the Company's factories at home and abroad. Mr. Stearn now removed to London, and subsequently directed the establishments of the Swan factories at Lilie and Cologne. In 1883 he was appointed a director of the Swan Company, and after the formation of the Edison-Swan Company and the separation for the second time of the English and foreign businesses, he resigned his connection with the English Company, and was appointed managing director of the Swan Company, which retained all its foreign patents and business, in 1885. In September, 1889, he terminated his connection with the Swan Company, and assumed the direction of the Zurich Incandescence Lamp Company at Birmensdorf, near Zurich, and London. Mr. Stearn is a member of the Institution of Electrical Engineers and the Physical Society of London, and a Fellow of the Royal Microscopical Society.

STEINMETZ, Charles Proteus. Born in Breslau, Germany, in 1865. Entered the University of Breslau in 1882, where he studied pure mathematics, astronomy, physics, chemistry, electro-technics and medicine.

After a short stay in Berlin in 1887, he found it advisable for political reasons to leave Germany, and went to Switzerland in 1888, where he entered the polytechnic school at Zürich, and studied mechanical engineering. In 1889 he went to the United States of America, where he became connected with the Eickemeyer and Osterheld Manufacturing Company in Yonkers, N.Y. On the consolidation of the Eickemeyer interests, in 1893, with the General Electric Company he joined the latter Company, and removed to Lynn, Mass. Since 1890 he has been carrying out an extensive research on the energy function of the magnetic circuit.

STOLETOW, Alexander G., Dr., Professor of Physics in the University of Moscow (Russia). Born in Vladimir, 1839; educated at the Gymnasium there, and at the Universities of Moscow, Heidelberg, Gottingen and Berlin; from 1862-65 he worked in the laboratories of G. Kirchhoff and W. Weber.

He graduated Master of Physics (Moscow), 1869, and Doctor of Physics, 1872. Appointed Lecturer of Physics at the University of Moscow, 1866; Extraordinary Professor, 1872; Ordinary Professor, since 1873; Emerit. Ord. Professor, 1891; hon. Member of St. Vladimir's University of Kieff, 1884; hon. Member of the Society for Natural Science, Moscow, 1886 (during 1881-89 President of the Physical Section); Member of the Mathematical Society, Moscow; Physico-Chemical Society, St. Petersburg; Société Française de Physique (Membre du Conseil 1888-90), Société Internationale des Electriciens (Membre du Conseil pour la Russie, 1891); Foreign Member of the Institution of Electrical Engineers, London. Was Member of the First Electrical Congress at Paris, 1881, and Member of the Jury (vice-president of Group IV.) at the Paris Electrical Exhibition, 1881; vice-president of the Second Electrical Congress at Paris, 1889. Author of many Papers on General Physics and Electrical Science in Russian and foreign periodicals. The chief electrical Papers are: "On the General Problem of Electrostatics" (purely theoretical); "On the Magnetization Function of Soft Iron" (contains the first exploration of the susceptibility-curve); "On a Determination of Maxwell's c" (by method of repeated discharge of an air-condenser of known dimensions); "On Contact Electricity" (versus F. Exner); "On Kohlrausch's Measurement of the Mercury Unit of Resistance" (calculation of self-induction); "On Actino-Electrical Phenomena" (a series of Papers on the dispersion of electricity of feeble tension under the action of ultra-violet radiations, on actino-electric cells, on a method of measuring contact electricity, &c.); "Ether and Electricity" (Address at the meeting of Russian Naturalists, 1890; &c., &c.

STROUD, Henry, M.A. (Camb.), D.Sc. (Lond.) Born in Bristol, August 7, 1851. Educated at Bristol Grammar School, University College, Bristol, Owens College, Manchester, and St. John's College, Cambridge.

He obtained the First Entrance Scholarship in 1879 at Bristol University College, and commenced the study of Physics under Prof. Silvanus P. Thompson. In June, 1880, he matriculated eighth in honours at the London University, and was awarded the Gilchrist Scholarship, tenable at Owens College, where he worked under Profs. Balfour Stewart and Sir Henry Roscoe till June, 1882. While at Owens he obtained the Heginbottom Scholarship for Physics and the Dalton Junior Mathematical Scholarship, and passed the Intermediate Science Examination at London, being placed first in the 1st class in the Honours Examination in Physics with the Neil Arnott Exhibition and Medal. In April, 1882, he was elected to a Foundation Scholarship of £100 per annum, tenable till of M.A. standing, at St. John's College, Cambridge, and commenced residence at Cambridge in October, 1882. He graduated B.Sc. at London in 1883, being placed in the Honours Examination first in the 1st class for Physics and first in the 1st class for Chemistry with the University Scholarship. In the Mathematical Tripos List of 1885 he was bracketed eighth Wrangler, and in 1886 was placed in the First Class for Physics in Part II. of the Natural Sciences Tripos, and obtained the Hockin Prize for Physics at St. John's College. He graduated Doctor of Science in the University of London in 1886, taking Electricity as his subject. On the resignation by Prof. A. S. Herschel of the active duties of the Chair of Physics at the Durham College of Science, Newcastle-on-Tyne, in 1886, Dr. Stroud was appointed Lecturer on Physics and Superintendent of the Laboratory, and in 1887 was elected to the Professorship of Physics, which post he has since held. During the visit of the British Association to Newcastle in 1889 Dr. Stroud acted as one of the secretaries of Section A.

For the last few years Dr. Stroud has been actively engaged in developing the Physical Department in connection with the extended work which the Durham College of Science

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JOSEPH WILSON SWAN.

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has recently undertaken ; and in conjunction with the Principal, Prof. Garnett, has devoted special attention to the technical education of students intending to become electrical engineers. He is a member of the Physical Society of London, and an honorary member of the North of England Institute of Mining and Mechanical Engineers.

STROUD, William, M.A. (Oxon.), D.Sc. (Lond.) Born in Bristol, February 2, 1860. Educated at the Bristol Grammar School ; University College, Bristol ; Owens College, Manchester ; Balliol College, Oxford ; and at the Universities of Heidelberg and Würzburg.

Prof. Stroud in 1879 gained the Gilchrist and Heginbottom scholarships at Owens College. In 1880 at the Intermediate Science Examination, in the University of London, he was placed first in the first class in chemistry, was awarded the University Exhibition, and was placed second in the first class in physics, and awarded a Neil Arnott medal. In 1881 he graduated as Bachelor of Science, being placed first in the first class in chemistry, with the University scholarship, and being placed in the second class in physics. In the same year he entered Oxford as a Brackenbury Scholar at Balliol, having decided to relinquish chemistry in favour of physics. He gained a first-class in the Final Mathematical School in 1884, and a first-class in the Science School, 1885. During the session 1884-5 he was studying physics under Profs. Quincke at Heidelberg, and F. Kohlrausch at Würzburg. In June, 1885, he graduated as Doctor of Science in the University of London, and was appointed to succeed Prof. Rücker in the Cavendish Chair of Physics at the Yorkshire College, Leeds. For the last six years, in conjunction with Prof. Barr, of Glasgow University, his spare time has been almost entirely devoted to the subject of Range-Finders for naval, military, and surveying purposes.

SUMPNER, W. E., D.Sc.

Dr. Sumpner was educated at University College, London, and at the Central Institution, South Kensington. At the former college he obtained the Rothschild's Exhibition for Mathematics, and at the latter the Clothworkers' Scholarship. He is a scholar in Physics of the London University, and a Fellow of University College. In 1887 he obtained the Paris Premium of the Society of Telegraph-Engineers for a Paper "On the Measurement of Self-Induction, Mutual Induction, and Capacity," and has contributed occasional Papers to the Physical Society of London, and to the Royal Society. In 1892 he was elected a Member of Council of the Physical Society, and has recently attained a similar distinction among the members of the Institution of Electrical Engineers. For some years he acted as Lecturer and Demonstrator in the Electrical Department of the Central Institution. This position he resigned on being appointed to take charge of the Electrical Department of the new Polytechnic at Battersea, London.

SWAN, Joseph Wilson, whose name is so widely known in connection with the invention of the incandescent electric lamp, was born in 1828, at Sunderland, and was educated at a private school in that town.

Mr. Swan at an early age entered the business of a chemist. While pursuing an active commercial life he yet found time for much scientific work, chiefly in the fields of photography and electricity, and he has left strong marks of his research and his inventive faculty in connection with both these departments of applied science. These are seen most conspicuously in the invention of the carbon or autotype photographic process, and the incandescent electric lamp. Our space does not permit us, nor does the occasion require us, to describe these inventions, nor to mention in detail the other inventions due to Mr. Swan's knowledge and ingenuity. Suffice it to say, these are both numerous and useful. Mr. Swan is a Fellow of the Institute of Chemistry, and of the Chemical Society ; and a member of the Institution of Mechanical Engineers and of the Institution of Electrical Engineers. He is also a corresponding member of the Philosophical Society of Glasgow, Master of Arts of the University of Durham, and Chevalier of the Legion of Honour of France.

SWINBURNE, James. Born at Inverness, February 28, 1858, and educated at Clifton College.

Mr. Swinburne served an apprenticeship of six years at a railway works and at Messrs. Black, Hawthorn and Co.'s establishment in Gateshead. Shortly after he was out of his time he went to the South Shields Gas Company, and was under Mr. W. J. Warner, the engineer. He was first in the City Guilds examination in gas manufacture in 1881. In the same year he was employed by Messrs. J. W. Swan and Co. to organise their lamp factory in Paris. He then went to America to do the same for the Brush people, who had bought Mr. Swan's American patents. On his return to England he was engaged in working out the glow lamp known by his name, and in making an exhaustive series of experiments in secondary batteries for Mr. Norman Cookson. Mr. Swinburne was manager of the Hammond Company's incandescent department, and has been scientific manager to Messrs. Crompton and Co. He now practises as a consulting engineer, and is a director of Swinburne and Co., Limited, of Teddington. He has published a small book on "Electrical Units," and another on "Electrical Measurement," and is an occasional contributor to *The Electrician* and other technical journals. He is a member of various scientific societies. He experimented on compound-winding, and had the first compound machines ever constructed made to his order in the spring of 1882. He is the inventor of several improvements connected with incandescent lamps, such as the system of butt-joint mounting now commonly used. His inventions include an electric governor ; compensation of voltmeters for temperature errors by means of wires of different temperature co-

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efficients; a Wheatstone bridge compensated for temperature; some forms of mercury pumps; the form of dynamo with small field-magnets and a hole-wound armature; an induction apparatus for determining the constants of a dynamo accurately before it is built; compound-wound direct-current transformers; an alternating motor; the form of open circuit transformer known as the "Hedgehog." He has also written Papers on secondary batteries, dynamos, and motors, transformers, safety devices, control and coupling of central station dynamos, testing dynamos, &c. The method of testing the efficiency of a dynamo or motor, used at the Paris Exhibition; the use of sodium sulphate for reducing "irreducible" sulphate of lead; and many smaller inventions, are due to him.

SWINTON, Alan A. Campbell. Born in Scotland in 1863.

Mr. Swinton entered Sir W. G. Armstrong's Elswick works in 1882 as a pupil, and in 1884 succeeded to the position of electrical engineer to the Company, in which capacity he superintended the electric lighting of all the war vessels built at Elswick up to 1887. During this period he introduced the system of wiring ships with lead-coated cable, since adopted by the English Admiralty, and in conjunction with Lord (then Sir William) Armstrong designed and laid down what is, it is believed, the first practical example of the bare copper conduit system of underground mains since so widely used for low tension distribution. In 1887 Mr. Swinton left Newcastle to take up his residence in London, retaining, however, the appointment of electrical adviser to Messrs. Armstrong, which he still holds. Since that date numerous electric installations have been erected under his superintendence. By appointment of the Secretary of State, Mr. Swinton is consulting electrical engineer to the Metropolitan Police, and he is managing director of the Scarborough Electric Supply Company. He has interested himself in telephonic matters, and took some part in the reorganisation of the New Telephone Company for the purpose of improving the London telephone service. Mr. Swinton has written two books on electric lighting—"The Principles and Practice of Electric Lighting," published in 1884; and "The Elementary Principles of Electric Lighting," first published in 1886, which has run to two editions. He exhibited curious photographs of electrical discharges at the 1892 *conversazione* of the Royal Society, and read a Paper on the subject of these photographs at the Edinburgh meeting of the British Association. He also exhibited original electrical experiments at the last two Royal Society *conversazioni*, among others the incandescing of an ordinary glow lamp by means of current passed through the human body. Mr. Swinton is an associate member of the Institution of Civil Engineers, and a member of the Institution of Electrical Engineers.

TESLA, Nikola, was born in Smiljan, a small place on the Austrian border, and is now 36 years of age.

He was educated principally at Carlstadt, Croatia. Returning home in 1873, during the cholera epidemic, he was affected by the disease, and for two years his further studies were temporarily interrupted. During this time, as much as his health permitted, he made experiments, principally in electricity. He then entered the Polytechnic School at Gratz, Austria, with the intention of graduating as a Professor of Mathematics and Physics, but, however, turned his attention to engineering, applying himself during his free hours to the study of electricity. He then entered the engineering department of the telegraph at Budapest, and in 1881 he turned his attention to the electric light and the construction of dynamo machines. The drawbacks of the commutator and brushes appeared to him so great that ever since 1875, when he first operated a Gramme machine, he thought incessantly of doing away with this defect on dynamos and motors. Early in 1882 he went to Paris, where he remained over two years in the service of one of the leading companies, and went in 1884 to America, where he has remained ever since, and where he has brought out a system of arc lighting, a potential regulation of dynamos and motors (which in one modification is now known as the "third Brush regulation"), a thermo-magnetic motor and generator, a double-disc dynamo, and various types of alternate-current motors. More recently he has been engaged in the study of alternating currents of high-tension and high frequency.

THOMPSON, N. G. Born at Ripon, Yorkshire; educated at Christ College, Finchley, and King's College, London; pupil for three years with Messrs. Simpson and Co., hydraulic engineers, London.

Commenced business with Mr. R. E. Crompton in 1878, and superintended the lighting of Mansion House, King's Cross Railway Station, and other important installations. In 1883 Mr. Thompson went to Moscow, where he carried out the lighting of the British Embassy during the coronation of the present Czar. On returning from Moscow Mr. Thompson entered into partnership with Mr. Rew, which partnership was dissolved in 1889.

THOMPSON, Silvanus Phillips. Born at York, June, 19, 1851; educated at the Friends' School, York.

Mr. Thompson subsequently studied at the Founders' College, and in 1869 graduated B.A. of London University. Having, however, a preference for science rather than literature, he studied to qualify himself for the post of science master in his former school at York. This post he abandoned for the sake of further study of chemistry and physics, and pursued courses in these subjects at the Royal School of Mines, supplemented by visits to the University of Heidelberg and other foreign institutions. In 1875 he graduated as Bachelor of Science of the University of London, being bracketed first in Honours; and in 1878 he took the further degree of Doctor of Science, selecting experimental physics as his subject for examination.

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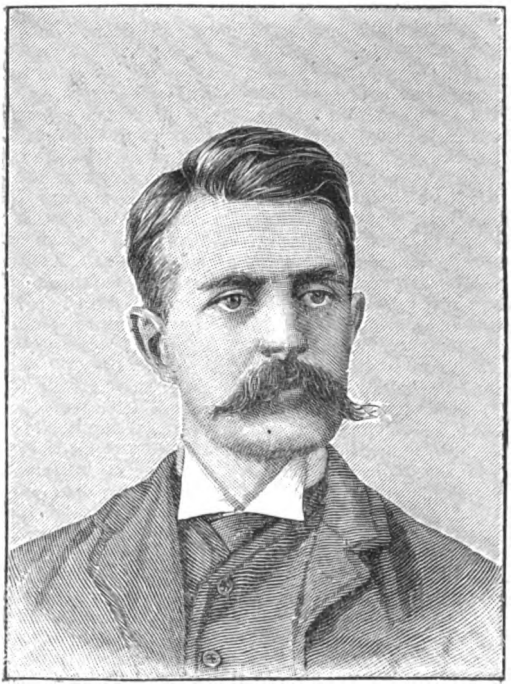

JAMES SWINBURNE.

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Meantime he had been acting as Lecturer in Physics in the then newly-established University College at Bristol, and had also begun to lecture under the Gilchrist Educational Trust. In 1878 he was appointed Professor of Experimental Physics in Bristol University College. In connection with this Chair he, in addition to the usual academical courses of lectures, delivered courses upon the Technical Applications of Electricity, upon Sound in relation to Music, and a special course of technical physics for engineers and builders. He had also the onerous duties not only of lecturing on Experimental and Mathematical Physics in the College, but of organising the Physical Laboratory of the College. From the time that he entered on his duties at Bristol, Prof. Thompson made important contributions to contemporary science. The *Reports* of the Physical Society of London and of the British Association bear witness to his zeal as a physicist, and his insight as an inquirer into physical, and chiefly electrical, phenomena. His investigations range from the chromatic aberration of the eye to the form of coils in the tangent galvanometer. The curious optical illusion, "strobic circles," was his discovery; and his application of the magnetic figures formed with iron filings to the illustration of electro-dynamic relations, and to the elucidation of the action of the dynamo-electric machine, are well known. Prof. Thompson also has the honour of having applied Clerk Maxwell's electromagnetic theory of light to the explanation of the behaviour of tourmaline crystals in their action upon polarised light, and he has even constructed electro-optic models of these crystals out of iron wire and glass. In the course of this investigation, which was largely mathematical as well as physical, he brought out a new proof of the fact—still not quite regarded by some physicists as settled—that the displacements in a wave of light are perpendicular to the so-called plane of polarisation. Prof. Thompson is, however, better known by his work amongst the applications of science than in the more recondite fields of abstract physics. His studies upon electrical storage and upon dynamo-electric machines are known to all electricians, and have received the recognition of the Society of Arts by the award of two silver medals. His Cantor Lectures on the latter subject, delivered in the autumn of 1883, at once established his reputation of being among the foremost in the special study of the construction, theory, and mode of working of dynamo-electric machines. The lectures then read before the Society of Arts formed the first really practical effort that had been made to examine this subject with anything like clearness and a thorough grasp. The success of Prof. Thompson's "Elementary Lessons in Electricity and Magnetism" has been remarkable, 40,000 copies having been printed in eight years in the English language, besides French, German, Italian, and Polish editions. In 1884 Prof. Thompson published his treatise on "Dynamo-Electric Machinery," which has run to four editions, and has been translated into French and German. He has also published several other works, including a biographical notice of Philip Reis—whose invention in the years 1860 to 1863 of the telephone that bears his name had been almost lost sight of in the fame of later improvements—a study of Apprenticeship Schools in France, and several pamphlets on Technical and Scientific Education.

Prof. Thompson's electrical library is second only to Mr. L. Clark's. When Prof. Ayrton was elected to the Chair of Physics at the Central Institute at Kensington, Prof. Thompson was elected to fill the vacancy at the City and Guilds Technical College, Finsbury, where his energy has increased and expanded the work of the classes with great success. He is also Principal of the Technical College. Besides discharging the ordinary duties of his appointment, Prof. Thompson has found time to continue his contributions to science pure and applied. In 1887 he communicated to the Society of Telegraph-Engineers and Electricians a Paper on his Telephonic Investigations, and in 1888 another on the Influence Machine. To the *Proceedings* of the Physical Society, of which he is a vice-president, he has contributed a number of Papers on Physical Optics and on Geometrical Optics. To the Society of Arts he has given two bibliographical Papers: one on the Development of the Mercurial Air Pump, and another on the Mechanism of Arc Lamps, both of which are replete with information. For the same society early in 1890 he delivered a series of Cantor Lectures on the Electromagnet, the outcome of six or seven years of work. His address on Electromagnetic Mechanisms, delivered as President of the Junior Engineering Society, is a continuation of the same topic. His book, "The Electromagnet," which is now in the second edition, and has been translated into French, German and Russian, is a greatly enlarged reprint of these lectures. He has also published in a pamphlet his lecture on "Electricity in Mining," which formed the topic of his 1891 lecture at the British Association. Prof. Thompson took the leading part in the founding of the Gilbert Club, and is actively aiding in the forthcoming translation of "De Magnete." In pursuance of the objects of this club, he has repeatedly lectured on the life and work of Dr. Gilbert. He is a Fellow of the Royal Society and of the Royal Astronomical Society, was one of the honorary vice-presidents of the Electrical Exhibition at Frankfort in 1891, and one of the British delegates to the Electrical Congress of Chicago in 1893, where he read a Paper on Ocean Telephony, in which he propounded the idea of accelerating the speed of signalling in cables by the use of inductive shunts at intervals along the cable.

THOMSON, Elihu. Born in Manchester, England, in 1853, of Scotch and English parentage.

At the age of five Elihu Thomson went with his parents to Philadelphia, U.S.A., where they settled. He was educated in the public schools of Philadelphia, and graduated at the Central High School in 1870. While at school he excelled in science and mathematics.

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During most of his school period he constructed and experimented with machines and apparatus of various kinds made with the crudest tools. He constructed when eleven years of age a successful frictional electric machine from a description, never having seen such apparatus. This was soon followed by voltaic batteries, telegraph instruments, Holtz machines, &c. Experiments in chemistry were taken up about the same time, and books on the subject diligently studied. As part of this he became interested in amateur photography at twelve, an interest which is still retained. After graduation at seventeen, he spent six months as analyst in a laboratory in Philadelphia, and first lectured in public about this time. He was then appointed Assistant Professor of Chemistry and Physics in the Central High School in the fall of 1870, having charge of the chemical laboratory. This position he filled until promoted to the chair of Professor of Chemistry and Mechanics in the same institution in 1875. During the period between 1870-6 he pursued his amateur work, and built a pipe organ of several stops with electro-pneumatic action of his own design, making pipes, keys, soundboard, &c. Among other things he constructed several compound achromatic microscopes, doing the lens work and brass work. One objective made contained ten lenses in the combination. He also experimented with arc lights from batteries, induction of currents, &c., which led him to construct much electrical apparatus. He lectured frequently on scientific topics, and had charge of the department of chemistry in the Artisans' Night School of Philadelphia. He was appointed lecturer on electricity at the Franklin Institute in 1877, and worked on its committees, notably the committee on dynamo-electric machines, the report of which was published in 1878. He had been at work on dynamo machines and electric lighting from 1874, and later associated with himself in such work Prof. Edwin J. Houston, his colleague for a short period. Several joint patents were taken out with Prof. Houston, notably the three-coil armature and regulation of current by the shifting of the commutator brushes. Upon these and other inventions the American Electric Company, afterwards the Thomson-Houston Electric Company, was organised in 1880, and Prof. Thomson became its electrician, resigned his professorship at the Central High School, and removed from Philadelphia to New Britain, Connecticut, where the works were first established. Prof. Houston, not being actively associated with the company at any time, remained in his professorship at the Central High School, which is still retained by him, and his association with Prof. Thomson in scientific work and invention ceased in 1880. Prof. Thomson, besides attending to the designing and manufacture of the well-known electrical apparatus of the Thomson-Houston Company, has taken out several hundred electrical patents in the United States for inventions, many of which have gone into extensive use. The work has covered the widest range of electrical engineering, and has necessitated thousands of experiments and resulted in the accumulation of a great number of first models, which are carefully preserved. The training which his early work of devising substitutes for expensive apparatus involved, the mechanical skill acquired, and the scientific and technical information at command have combined to secure successful invention and development. Prof. Thomson is also the originator of the electric welding and metal working processes which bear his name, the developments of which have necessitated a vast additional amount of study in new lines. He has been a frequent contributor by Papers and correspondence to the electrical and technical journals, and to societies, of many of which he is a member. His discoveries in connection with the actions of alternating currents, in the application of which currents he was a pioneer, are particularly noticeable. He served as President of the American Institute of Electrical Engineers in 1889. In recognition of his electrical work he was decorated Officer of the Legion of Honour at Paris in 1889, in addition being awarded the Grand Prix at the Paris Exhibition for the apparatus he exhibited illustrating his inventions. In 1890 the honorary degree of Master of Arts was conferred on him by Yale University. Prof. Thomson experimented early in 1879 with closed iron circuit transformers in multiple with reduction of potential; was the first to employ a field-exciting coil around the armature of a dynamo, giving rise to the first "iron-clad" type; originated the air blast applied to switches and commutators; first applied arc rupturing devices to lightning arresters and switches; designed and applied electromagnets with uniform attraction of armature to various constructions such as arc lamps and regulators; originated the grounded sheath between primary and secondary of transformers, and applied the grounded secondary of his invention. He invented the static or film cut-out or shunting device, closing itself through a layer of highly resisting material, the vacuum cut-out in which a vacuous space is used as the resisting layer, invented and applied variable reactive coils for controlling alternating currents, and used them for the first time as substitutes in a circuit for lamps instead of using resistances. He invented and applied the counter-distorting or inclined series coil over the armatures of dynamos, shunting devices for series incandescent lamps, the compensating or energy transferring system, in which a reactive coil or transformer is used in a three-wire system or the like for balancing the consumption on the two sides. He originated the type of motor for alternating currents called the "transformer motor," and applied the principle of inductive repulsion discovered by him to indicators, arc lamps, regulators, &c. He invented the evaporation meter, and applied the principle to other devices. In addition to work in electric welding, he has of late been most actively engaged in the development of the railway work of the Thomson-Houston Electric Company along with his work in electric lighting and power. The Paris

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ELIHU THOMSON.

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Commission of 1890 for examination of electric meters divided the first prize between the Aron meter and the Thomson meter, as both instruments fulfilled the conditions of the award.

THOMSON, J. J., M.A., Hon. Sc.D. (Dublin), F.R.S. Born in 1856, at Cheetham Hill, near Manchester.

Student for five years at the Owens College, Manchester, of which he is an Associate. While at the Owens College he worked in the Physical Laboratory under the late Prof. Balfour Stewart. In 1876 he entered Trinity College Cambridge, as a Minor Scholar; he was elected to a Major Scholarship in 1878, to the Sheepshanks Astronomical Exhibition in 1879, and took his degree as second wrangler and second Smith's Prizeman in 1880. He was elected a Fellow of his College in 1880, and appointed Mathematical Lecturer in 1882. In this year he gained the Adams Prize for an essay on the Motion of Vortex Rings. In 1884 he was elected a Fellow of the Royal Society, and in the same year he succeeded Lord Rayleigh as Cavendish Professor of Experimental Physics in the University of Cambridge. He is the author of numerous Papers, and of a "Treatise on the Motion of Vortex Rings," "The Application of Dynamics to Physics and Chemistry," and "Recent Researches on Electricity and Magnetism." He is a Fellow of the Mathematical Society, and Vice-President of the Cambridge Philosophical Society.

TOMLINSON, Herbert, B.A., F.R.S.

Mr. Tomlinson was educated at St. Peter's School, York, and at Christ Church, Oxford, where he gained an open mathematical studentship. In 1868 he graduated as B.A. both in the Mathematical and Natural Science Honours' Schools; in 1870 he was elected one of the Whitworth Exhibitioners of the University of Oxford; and in the same year was appointed Demonstrator and Lecturer on Natural Philosophy at King's College, London, which post he still retains. In 1889 he was elected a Fellow of the Royal Society, in consideration of his original researches in physics. As a writer on physics Mr. Tomlinson is well known through his numerous contributions to the *Transactions* and *Proceedings* of the Royal Society, the *Philosophical Magazine* &c., the most important of which relate to the effects of mechanical stress on the electrical, magnetic, and other physical properties of metals. The following Papers may be enumerated:—"Effect of Magnetisation on the Electrical Conductivity of Iron" (1875); "Increase in Resistance to the Passage of an Electric Current produced in certain Wires by Stretching" (1877); "Alteration of Thermal Conductivity of Iron and Steel caused by Magnetism" (1878); "Moduli of Elasticity," and "Electrical Conductivity" (1883); "Note on Hall's Phenomenon" (1884); "Relations between Moduli of Elasticity, Thermal Capacity, and other Physical Constants;" "Alteration of the Electrical Conductivity of Cobalt, &c., by Longitudinal Traction," and "On Certain Sources of Error in Connection with Torsional Vibration" (1885); "The Effect of Pressure on the Electrical Resistance of Carbon," "The Coefficient of Viscosity of Air," "The Internal Friction of Metals," "The Effect of Change of Temperature on the Internal Friction and Torsional Elasticity of Metals," and "Temporary and Permanent Effects Produced on Some of the Physical Properties of Iron by Raising the Temperature to 100°C." (1886); "The Velocity of Sound in Metals, &c.," "Magnetic Induction," "The Effect of Change of Temperature in Twisting or Untwisting Wires which have Suffered Permanent Torsion," "Remarkable Effect of Raising Iron when under Temporary Stress or Permanent Strain to a Bright-Red Heat," and "The Effect of Magnetisation on the Thermo-Electrical and other Physical Properties of Bismuth" (1887); "The Effect of Magnetisation on the Elasticity and Internal Friction of Metals," "The Effect Produced on the Thermo-Electrical Properties of Iron when under Stress or Strain by Raising the Temperature to the Bright-Red," "The Recalescence of Iron," "Temperature at which Nickel begins to suddenly Lose its Magnetic Properties," "The Thermo-Magnetic Properties of Iron and Nickel" (*The Electrician*), and "A Theory concerning the Sudden Loss of the Magnetic Properties of Iron and Nickel at certain Temperatures" (1888); "The Effect of Repeated Heating and Cooling on the Electrical Resistance of Iron," and "The Internal Friction of Iron, Nickel, and Cobalt, studied by means of Magnetic Cycles of very minute range" (1889).

TOMMASI, Donato. Born at Naples, December 22, 1848.

Dr. Tommasi has done good work as a chemist and electrician. He is a contributor to the scientific press, and a member of numerous learned societies, amongst which are the Chemical Societies of London, Paris, Brussels, and Edinburgh, the Société de Physique, the Société Electrotechnique de France, the Société Internationale des Electriciens, &c., &c. His contributions to various scientific journals are both voluminous and valuable. The following is a list of the most interesting Papers:—"Sur un Nouveau Système de Télégraphie Pneumatique;" "Sur une Nouvelle Source de Magnetisme;" "Action du Froid sur l'Arc Voltaïque;" "Sur l'Electrolyse de l'Eau;" "On the Reduction of Chloride of Gold by Hydrogen in the Presence of Platinum;" "Sur le Travail Chimique produite par la Pile;" "Influence de l'Electrode Positive de la Pile sur son Travail Chimique;" "Sur l'Electrolyse de l'Eau Distillé;" "Sur l'Électrolyse;" "Relation entre la Force Electromotrice de la Pile et les Calories de Décomposition de l'Eau;" "Sur l'Emploi des Couples en Charbon dans l'Electrolyse;" "Chaleur due à l'Aimantation;" "Sur l'Electrolyse de l'Acide Chlorhydrique;" "Conservation de l'Energie Solaire;" "Sur un Nouvel Accumulateur à l'Électrodes en Charbon Plombifère;" "Equivalents Electro-Chimiques;" "Régulateur photo-électrique à Sélénium;" "Eclairage des Trains de Chemin-de-Fer par l'Electricité combinée avec le Gaz;" "Chauffage des Trains de Chemin-de-Fer par l'Electricité;" "Pile à Electrodes de Charbon;" "Liquefaction des Gaz;" "Nouveau Système de Transmission

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Téléphonique et Télégraphique ;" "Relais différentiel pour Téléphones et Télégraphes ;" "Des diverses Causes de Dégagement d'Electricité ;" "Dispositif de Transmission Multiplex pour Communications Téléphoniques ;" "Nouvelles Cartouches de Mine ;" "Accumulateur Multitubulaire ;" "Lampe Électrique de Sûreté pour les Mines ;" "Electrolyseur pour l'Extraction, la Séparation et l'Affinage des Métaux." Dr. Tommasi has also published the following works :—"Traité Théorique et Pratique d'Electrochimie ;" "Traité des Piles et des Accumulateurs Electriques ;" "Traité de Galvanoplastie."

TROUTON, Frederick Thomas, M.A., D.Sc. Born in Dublin, November 23, 1863 ; educated at the Royal School, Dungannon, and Trinity College, Dublin.

Mr. Trouton graduated B.A. in 1884, obtaining the large gold medal in Chemistry and Physics ; in the following year he took his degree in the Engineering School, Trinity College. In 1884 he was appointed assistant to the Professor of Physics in the University of Dublin. Mr. Trouton is the author of Papers on various subjects, including "The Temporary Thermocurrents in Iron," "The Rate of Propagation of Induced Magnetisation in Iron." He undertook in 1885, at the instigation of Prof. Fitzgerald, for the British Association Committee on Electrolysis, investigations with the view of verification of Ohm's law in electrolytes, a work extending over two years. Since 1889 Mr. Trouton has contributed to *Nature* and elsewhere accounts of the repetition of many of Prof. Hertz's experiments with electromagnetic radiation, and in addition of experiments devised to illustrate the identity of electromagnetic radiation with light made in imitation of well-known optical experiments, such as interference in thin plates, diffraction, and polarised reflection from non-conductors, by the latter of which it was possible to decide experimentally on the direction of vibration in polarised light.

TROUVÉ, Gustave. Born at Lahaye, Descartes, France, January 1, 1839.

M. Trouvé is a scientific instrument maker, engineer, and constructor, patented Lauréat de la Faculté de Médecine de Paris, Membre Lauréat de l'Académie Nationale Agricole, Manufacturière et Commerciale, de l'Association Française pour l'Avancement des Sciences, and de la Société d'Encouragement pour l'Industrie Nationale, Chevalier de la Légion d'Honneur. During his early years M. Trouvé manifested a decided predilection for the applied sciences, and studied with great assiduity, his only amusement being the construction of various kinds of miniature telegraphic apparatus. At the age of seven years he contrived and finished a steam engine, which, despite its Liliputian proportions, worked with precision. In the Collége de Chinon, where he commenced his actual studies, M. Trouvé displayed an especial aptitude for the mathematical and mechanical sciences, and when he had passed through a course of instruction at the establishment we have named, he quitted his native town for the purpose of entering l'Ecole des Arts et Métiers d'Angers ; and afterwards went, at the age of twenty, to Paris, in order that he might further perfect himself. In 1866 M. Trouvé established his workshop for the manufacture of instruments of precision, and soon entered into relations with the principal physicians of Paris, for one of whom he designed and executed, in three days, the instrument known as "explorateur-extracteur-électrique," a contrivance for localising and facilitating the extraction of projectiles from the human body. He has obtained for his apparatus honourable mention at the Paris Exhibition of 1867 ; silver medal of the Société d'Encouragement in 1870 ; Progress medal at the Exhibition of Vienna, 1873 ; gold medal at the Académie Nationale, 1875 ; Barbier prize of the Faculté de Médecine in 1875 ; gold medal at the Universal Exhibitions of Paris, 1878 and 1889 ; six diplômes d'honneur at the Académie Nationale, 1877, 1879, 1885, 1891-1892, and at the Antwerp Exhibition in 1891 ; and the Melsen Prize in 1893 ; independently of many other gold and silver medals which he has at different times been awarded for home and foreign exhibits. The inventions and other works of M. Trouvé are almost innumerable ; among the principal of them, however, may be mentioned "the double movement electro-spherical motor," which demonstrated the law of Newton that the action is equal to the reaction, and the force to the resistance, and which is employed at the present time to demonstrate the reactions in Prof. Crookes's radiometer ; the reversible hermetic battery (1865), presented to the Académie des Sciences in December, 1867, by the late M. Becquerel ; the electric gyroscope (1865) ; the electric gun (August 9, 1866) ; the electro-medical pocket case, presented to the Académie des Sciences (1867) ; apparatus for experimentally and immediately determining the best angle of inclination of a screw for any given force (1867) ; military portable telegraph, presented by the late M. du Moncel to the Société d'Encouragement in 1872 ; a constant and continuous cell, said by Trouvé to be more constant than the Daniell—which was presented by M. Becquerel to the Académie des Sciences in 1873, and to the Académie de Médecine by M. Gavarret in 1874 ; a dynamo-electric or magneto-electric machine (1875) ; an electro-magnetic apparatus registering the number of its alternations—which placed in evidence the mode of muscular contraction—presented to the Académie des Sciences (1877) ; a new electric reversible motor (1880) ; application of electric motors to pleasure boats (1881) ; an electric tricycle, travelling 15 kilometres (9·32 miles) per hour (1881) ; application of the Trouvé electric motors to balloons (1881) ; practical solution of domestic electric lighting (1883) ; the Trouvé-Helot electric photophore (Académie des Sciences, April 16, 1883) ; the Trouvé universal electric safety lamp (1884) ; an electric guidon and electric projector for shooting during the night (Académie des Sciences, July 7, 1885) ; electric apparatus for the lighting of physiological, botanical, chemical, micrograph, &c., laboratories (presented by M. de Lacaze-Duthiers to the Académie des Sciences August 3, 1885, and

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by M. Gariel to the Académie de Médecine, March 2, 1886); a new mode of constructing screws for ships (Académie des Sciences, July 12, 1886); an electric siren, a signal of alarm for boats, canoes, &c. (July 12, 1886); Trouvé's electric "Helicoptère" and "Aeroplane," rising in the air by means of an exceedingly light motor provided with an atmospheric screw and worked by an electric current; a new "Interrupter Commutator," suppressing the rupture spark in electric currents of great intensity; Trouvé's electric "Auxanoscope," for the projection of opaque or transparent objects (Scientific Congress of Toulouse, September 26 and 28, 1887); Trouvé's electric fraiseuse for dentists' use (April 26, 1888); Trouvé's "Universal Dynamometer," with "teletachometer," for long-distance multiple and simultaneous indications (Nov., 1888); a universal meter for measuring electricity in any form; Ascanio lights (Paris Opera, April, 1890); hand-worked dynamos for demonstrative purposes (May, 1890); miners' lamp and orygmatoscope (Académie des Sciences, August 18, 1890); electric gyroscope and marine gyroscope (Académie des Sciences, August 25, 1890); Trouvé combined gas and electric lighter; a system of aerial navigation by a heavier medium than air (Académie des Sciences, August 24, 1891); a new system of maritime navigation with sea-water battery (Académie des Sciences, August 31, 1891); Trouvé luminous fountain for table and hall, changing appearance and colour (Académie des Sciences, October 12, 1891); monumental luminous fountain with automatic changeable colours (Académie des Sciences, September 12, 1892); physiological and medical dynamometers, rheostatic balance (1892); and he indicated in his pamphlet, "A New Process of Fishing" (1893), some great improvements in fishing apparatus. M. Trouvé has endowed science with apparatus of incalculable value. Among the most curious and most useful of his inventions is the electric polyscope, which he perfected in 1869; by its means a thorough diagnosis of the diseases of the throat, the ear, the eye, or any hidden part of man's organisation, can easily be made; also the electric explorer for and extractor of projectiles, which has been adopted and placed in military chirurgical pocket cases. M. Trouvé, who is the author of a "Manuel théorique, instrumental et pratique d'Electrologie médicale," was named Chevalier of the Legion of Honour by decree of the President of the Republic on the 29th of December, 1881.

TUNZELMANN, G. W. de. Born in London in 1856; educated at Elizabeth College, Guernsey; after a few years' pupilage in the drawing office of a civil engineer, he matriculated at London University, and entered University College, London, in 1873, where he studied mathematics and physics under Henrici, Clifford, and Carey Foster, and engineering under Kennedy, in addition to other subjects taken up for general culture.

In 1876 Mr. Tunzelmann took the exhibition given by the Clothworkers' Company in Chemistry and Physics at University College, and he then worked in the physical laboratory under Prof. Foster until 1878, working also for a part of the time in Dr. Williamson's chemical laboratory. In 1878 Mr. Tunzelmann read a Paper at the Physical Society, on "The Production of Thermo-Electric Currents by Mechanical Strain," and in the same year he took the scholarship given by Baroness Meyer de Rothschild for pure and applied mathematics at University College. In 1878 he took his degree as B.Sc., London University. From 1876 to 1878 he acted as Dr. Henrici's assistant in mathematics. In 1877 he was elected a member of the London Mathematical Society and of the London Physical Society; in 1890 he became a member of the Institution of Electrical Engineers; and in 1892 he was elected a member of the Société Internationale des Electriciens, Paris, and of the Electro-Technical Society of Berlin. In 1881 he was asked by Prof. Foster to undertake some experimental work he had in hand for the British Association, *i.e.*, testing a method devised by him for obtaining the value of the ohm. The results are embodied in the British Association "Report," and also appeared in *The Electrician* during 1881. In September, 1881, he was appointed instructor in natural philosophy and astronomy on board Her Majesty's ship "Britannia," training ship for cadets, which position he resigned in 1884. In 1882 he was appointed assistant examiner in magnetism and electricity to the Science and Art Department, South Kensington, an appointment which he still holds. He has contributed largely to the scientific and technical journals, including *The Electrician*, *Nature*, *Industries*, *Engineering*, and various foreign journals, and has written numerous popular articles for different periodicals. He is the author of "Electricity in Modern Life," one of the volumes of "The Contemporary Science Series," and he is at present the principal and Professor of Physics and Electrical Engineering in the Electrical and General Engineering College, Earl's Court, London, S.W.

TWEEDDALE, Marquis of, is the tenth marquis, and was born in 1826. He was educated at Haileybury College.

The Marquis of Tweeddale was formerly in the Bengal Civil Service, having been Deputy-Commander of Simla, and Superintendent of Hill States in Northern India. His second title is that of the Earl of Gifford. He sits in the House of Lords as Baron Tweeddale. Sat as M.P. for Taunton in 1865-8, and for the Haddington Burghs in 1878. The Marquis of Tweeddale has interested himself considerably in the promotion of submarine telegraphy, and is chairman of the Anglo-American Telegraph Company, vice-chairman of the Eastern Telegraph Company, a director of the Eastern Extension, Australasia and China Telegraph, and of the Globe Telegraph and Trust Companies, and trustee of the Submarine Cables Trust.

UNWIN, Prof. W. C. Educated at the City of London School.

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On the completion of his apprenticeship at the works of the late Sir William Fairbairn at Manchester, he was for some years manager of engineering works in Kendal and Manchester. In 1867 he was appointed Instructor in Marine Engineering in the Royal School of Naval Architecture and Marine Engineering, then at Kensington. In 1871 he was appointed Lecturer and Examiner, and in 1872 Professor of Mechanical and Hydraulic Engineering at the Royal Engineering College, Cooper's Hill. In 1884 he was appointed Professor of Engineering at the Central Institution of the City and Guilds Institute for the Promotion of Technical Education, at Kensington, and has been Dean of the Institution since its opening. He is a Fellow of the Royal Society, a member of the Institutions of Civil Engineers and Mechanical Engineers, member of the American Philosophical Society, hon. member of the Franklin Institute, member of the Society of Arts, and honorary associate of the Royal Institute of British Architects. He is the author of various Treatises and Papers in the *Transactions* of scientific societies, amongst which may be mentioned "Wrought Iron Bridges and Roofs" (1869); "The Elements of Machine Design" (of which the 11th edition was published in 1891); "The Testing of Materials of Construction" (1888); Cantor Lectures (1887); Howard Lectures (1893). In 1890 he was appointed Secretary of the International Niagara Commission; and in 1892 he was President of the Mechanical Section of the British Association.

UPPENBORN, F. Born January 29, 1859, at Hanover.

Mr. Uppenborn studied physics and engineering at the Technical High School at Hanover. In 1881 he became editor of the *Centralblatt für Elektrotechnik*, the first journal of applied electricity in Germany. In 1882 and 1883 he was engineer-in-chief of the well-known firm of S. Schuckert, Nurnberg; since 1883 he has had a factory for dynamos at Hanover; and since July, 1886, he has been director of the "Elektrotechnische Versuchs-Station" at Munich, a public electrotechnical laboratory. In January, 1890, he removed to Berlin, where he united the two German journals *Elektrotechnische Zeitschrift* and *Centralblatt für Elektrotechnik*. He has contributed to the theory of dynamos, of transmission of power, and to several methods of measurement.

UPWARD, A. Réné. Born in London in 1861, and mainly educated by private tuition in Lincoln's Inn.

In 1878 Mr. Upward was admitted as a pupil to the Woolwich works of Messrs. Siemens and Co., where within a few months he was made a member of the staff by the late Sir William Siemens. Having passed through the various departments of these large works, Mr. Upward began the study of chemistry, mainly in its relation to metals, under the late Prof. Bloxham, King's College, supplementing this by visits to the coal pits and ironstone mines of the Yorkshire district. In 1882 he revisited the Messrs. Siemens' works at Woolwich, to carry out some experiments on a new Siemens arc lamp and other apparatus. Subsequently he became head electrician to the Woodhouse and Rawson Electric Manufacturing Company, Limited, which position he held for five years, during the most active time of the electric lighting development. From time to time during this period Mr. Upward also conducted a long series of experiments and tests on secondary batteries, new types of electrical measuring instruments, electrochemical processes, &c., also devising for this Company special methods for rapid and accurate tests, determination of constants, exact calibration of instruments, and other special means and devices for accurate electrical measurements adapted to the requirements of an unusually large factory where nearly every description of electrical work was undertaken. After his connection with this Company he acted for and advised the Wenham Light Company, Limited, and the House-to-House Electric Light Company, Limited, together with other well-known undertakings. Mr. Upward is well known as the inventor of the gas battery bearing his name, an account of which first appeared in *The Times* in July, 1886. The electrolytic action of the "Upward chlorine cell" is now well known and has been minutely and critically examined and exhaustively reported upon by Dr. Oliver J. Lodge, whose report was published in the electrical press at the time. Shortly after bringing out this invention, Mr. Upward communicated a Paper to the British Association meeting of 1886. Mr. Upward is the author of inventions apart from electrical science, notably researches on liquefied gases and their practical application. The late Sir Morell Mackenzie was specially interested in a machine actuated by this form of stored power, designed by Mr. Upward, for giving antiseptic sprays at any required interval night and day continuously, the machine being completely self-acting and capable of working for months without attention or adjustment.

VAN TROMP, Benjamin Humphries. Born at Delft House, Somersetshire, in 1830.

Mr. Van Tromp commenced his professional career in London as a Parliamentary agent in 1860. After a few years he determined, however, to enter the legal profession, and with this object associated himself with Messrs. Johnson, Farquhar, and Leech, with whom he served his articles. These gentlemen were the well-known solicitors for the Great Northern Railway Company from the commencement of that enterprise. Mr. Van Tromp remained associated with this firm until 1869, when he commenced practice on his own account. Mr. Van Tromp is a lineal descendant of the great Dutch Admiral, Cornelius Van Tromp, who was created Earl of Selsburg by the King of Denmark, and a Baronet of the United Kingdom by Charles II. in 1675. Many interesting relics of his ancestors are treasured at his residence in Hyde Park-terrace. His first introduction to the world of electricity was as solicitor for the

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London and Provincial Telegraph Company, originally called the London District Telegraph Company, of which Mr. Charles Curtoys (*see* page XXII.) was the Manager and Secretary. He has practised as a solicitor since 1869, and is now head of the firm of Messrs. Van Tromp and Co., in Essex-street, Strand, but does not take an active part in the conduct of the business, his time being almost entirely absorbed by his position as director of several public companies. Some years ago he accepted a seat at the Board of the Australasian Electric Light, Power, and Storage Company—one of the numerous offshoots of "Father Brush"—and as Chairman of that Company it was chiefly through his exertions, foresight, and tact that arrangements were made with the Brush Electrical Engineering Company, of which Lord Thurlow was then Chairman, whereby the shareholders were saved from the entire loss of the money invested in the Australasian Company, and as a proof of their confidence in him he was unanimously elected to a seat on the Board of the Brush Company. He is also Chairman of the Continental Metropolitan Tramways Company, the owners of the entire system in Paris known as the "Tramways Sud," with a capital of half a million. He is a firm believer in the future of electric traction, and on all occasions has persistently advocated its adoption. He is now, with his colleagues, using every effort to get this motive power introduced on the Paris tramways. Mr. Van Tromp is Chairman of the Brighton Grand Hotel Company, one of the original directors of the Electric and General Investment Company, which Company was formed for the purpose of assisting electrical enterprise, and the formation of companies for the development of all branches of electric work, and Director of the Dover Electric Supply Company.

VARLEY, Frederick Henry. Born in London.

Mr. Varley is the youngest son of the late Cornelius Varley, the members of whose family are more or less identified with electric science. He was educated at a private seminary in Islington, and had the run of his father's studio, laboratory, and workshops, and also accompanied him to the Royal Society, Royal Institution, Society of Arts, Microscopic and other learned societies and scientific meetings, which the late Cornelius Varley zealously attended. In 1859 Mr. Varley joined his father's firm, and aided in the construction of the translating apparatus and polarised relays for the Electric and International Telegraph Company, and the inventions of his brother Cromwell F. Varley, who became engineer-in-chief to that company. Mr. Varley also constructed for his brother rheostats, differential galvanometers and bridges, and continued in similar employment until 1868-9. In 1864 he constructed and adjusted the coils for Sir William Thomson's slides and C. F. Varley's subdividers, being part of the first testing apparatus employed in the continuous ship-to-shore testing. In 1865 he was temporarily employed in testing the Atlantic cable, afterwards rejoining his father's firm. In 1868 he accompanied the Reuter Cable Expedition, and acted as assistant engineer in the laying of that cable from Lowestoft to Norderney. In 1869 he took out his first patents for improvements in testing apparatus. Together with his late brother, Octavius Varley, he started in business as manufacturing and consulting electrical engineers, when they continued making testing apparatus for various important firms. Mr. F. H. Varley is the patentee of improvements in ink-writing Morse instruments in use in Australia, and of a railway block system employed in North Britain, and as a contractor has erected telegraph lines both in the North and South of England. In 1881, in conjunction with his late brother, Cromwell Fleetwood Varley, he invented and patented improvements in cymaphens, or apparatus for the transmission of undulatory currents; also improvements in electric arc lamps. At the same time Mr. F. H. Varley perfected his process for the manufacture of flexible carbons, which he patented in 1882. Mr. Varley found that a current of 400 watts, capable of maintaining an arc between hard carbon poles not more than ¼in. apart, would produce with flexible carbon electrodes an arc from 2in. to 3in. in length. Mr. Varley also employed flexible carbon in plates, sheet, and cord for making rheostats, variable resistances, and for other purposes. He has invented a lamp for burning the flexible carbon, patented the use of this material as a filtering septum, constructed primary and secondary batteries, and likewise has produced a filament for incandescent lamps which is a compound of boron and carbon.

VARLEY, S. Alfred. Born in London, March 2, 1832; is the third son of the late Mr. Cornelius Varley, an active scientist and artist, and one of the founders of the Old Water Colour Society, now the Royal Institute.

Mr. Varley at an early age used to accompany his father on Sundays to a little chapel, the leading Elder of which was Michael Faraday, to whom he was taught to look up in the two-fold capacity of religious teacher and scientific exemplar. At the age of 14 Mr. Varley commenced to study chemistry, and attended every scientific lecture he could obtain access to. In 1849, when electric illumination was being publicly advocated by Staite, Mr. Varley, in conjunction with his elder brothers, made numerous experiments, constructing with his own hands some hundreds of battery cells, but the troublesome manipulation attendant on their use caused him to turn his attention to magnetism. On the completion of his experiments in magnetism, Mr. Varley designed and commenced making a machine whose leading features were constructing the field-magnets of bundles of tempered steel wires, and wrapping the central portion of the revolving armatures with insulated wire, instead of the extremities only, as was the case with the Sexton machine. Chiefly from not having the command of engineering tools the machine was only partly made, and never completed. In 1852 Mr. Varley entered the service of the Electric Telegraph Company, and assisted

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in some experiments on the retardation of electric signals through underground and submarine circuits, which led to the development of C. F. Varley's double-current system. In 1854 Mr. Varley was appointed to the charge of the telegraphs of the Liverpool district. About this time he constructed an electric chronograph to measure the small intervals of time occupied by the passage of the electric signal to time balls and the time lost in the discharging apparatus. He also made the time ball to automatically record the fact of its having been discharged, so that the station from whence the signal emanated could see that the apparatus had acted properly. The improvements he effected at this period led subsequently to Mr. Varley being entrusted with designing time-ball apparatus for the Cape, India, China, and other places. In the spring of 1855 Mr. Varley was appointed to the charge of the first field telegraphs used in war, and proceeded to the Crimea. After the fall of Sebastopol he took charge of the submarine telegraph connecting Constantinople and Varna. In 1858, when the Atlantic cable was being constructed, he wrote a Paper read before the Institution of Civil Engineers "On the Electrical Qualifications Requisite in Long Submarine Cables," and was shortly afterwards elected an associate member of that institution. In the Paper above referred to, Mr. Varley opposed the views of the electrical advisers of the Company. Faraday, who had publicly supported the views of the scientific advisers of the Company, endorsed Mr. Varley's views immediately after receiving a copy of his Paper. Mr. Varley followed up his first Paper by reading a second one before the Society of Arts, in 1859, "On the Practical Bearing of the Theory of Electricity to Long Submarine Telegraphy." In this Paper, among other things, he suggested the use of artificial lines, which have since proved of such value in connection with duplex working, and described in detail one he was at that time constructing. In 1866 Mr. Varley discovered the reaction principle, and constructed the first machine of the pure dynamo type. This machine is now in the Museum at South Kensington, and for having designed the first self-exciting dynamo Mr. Varley was awarded the Gold Medal of the Inventions Exhibition of 1885. In 1866 he introduced needle-telegraph coils, in which soft-iron magnetically-induced needles were substituted for tempered steel needles. These induced and consequently undemagnetisable needles have entirely superseded the older form introduced by Wheatstone and Cooke, and are largely adopted by the Postal Department as well as for railway telegraphs and signalling instruments. In the same year (1866) he designed a system of electric train inter-communication. In 1876 Mr. Varley patented a series-shunt or compound-wound dynamo, which came under the purview of the Scotch Law Courts in the suit of Messrs. King, Brown and Co. *v.* The Anglo-American Brush Corporation; and Mr. Varley's claim to have first described a system of compound-winding was fully sustained in the Outer House of the Court of Session, Edinburgh (June 27, 1889), on appeal to the First Division of the Court (July 16, 1890), and on the further appeal of the Anglo-Brush Corporation to the House of Lords, judgment was given (April 5, 1892) in Mr. Varley's favour without their lordships hearing defendants' counsel.

Mr. S. A. Varley has from time to time contributed Papers read at the meetings of the British Association, among which may be mentioned one "On the Mode of Action of Lightning on Telegraph Circuits," in which he demonstrated that it was the secondary current developed in the telegraph wire after the lightning discharge, and not the lightning discharge itself, which frequently burnt up the instruments when they were protected by a lightning conductor, and he described a lightning bridge designed by himself which opposed a decreasing resistance to an increasing electric potential. A number of these bridges are still doing duty after more than twenty years' use.

VOLK, Magnus, A.I.E.E., M.S.A. Born at Brighton, October 19, 1851. Educated at private schools.

Mr. Volk was first interested in electricity owing to the description of the single-needle instrument in a prize book gained at school, and he devoted all his spare time to the construction of electrical instruments and models worked by steam. On the death of his father, and when only 15 years of age, he was thrown upon his own resources for a livelihood. Various electric toys were experimented upon, and a model single-needle telegraph was constructed. This proved a great success. In a short time about 60,000 were sold, a large number of hands being employed in their manufacture. About this time he wrote various articles in the *English Mechanic*, which brought him under the notice of Captain Harvey, then experimenting with his towing torpedo. Mr. Volk constructed various apparatus for him, which led to his introduction to Messrs. Vavasseur and Co., for whom, under Captain M'Evoy, he constructed considerable quantities of torpedo apparatus, upon which he was employed for some three or four years. He was next engaged in converting the Martini-Henri rifle into a magazine gun, and had just completed the first apparatus when a sudden and nearly fatal illness caused the loss of the business, and necessitated a fresh start. An opportunity occurred upon the development of the telephone business, and he was then employed by the United Telephone Company to remodel and design various apparatus, also to develop the business in the Brighton district. During this time he experimented in electric lighting, dynamo construction, &c., with such success that the corporation placed the electric lighting of the Royal Pavilion in his hands, an installation numbering about 1,100 lamps. The electrical transmission of power next claimed his attention, and to procure sufficient scope for experimenting, application was made to the Council to grant the use of a strip of ground under the sea-wall to lay an experimental line, which was granted. The first installation consisted of a two horse-power gas engine, a

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Siemens SD5 dynamo as generator, and an experimental dynamo as motor, fitted into an open car seating ten or twelve persons. The track was about 400 yards long. In a few weeks over 30,000 persons patronised the venture. Application was then made to extend it along the front, but was refused, though permission was afterwards granted as far as the eastward extension was concerned. This railway, which is worked on the third-rail system, has been in existence eleven years, and is patronised during the summer months to its fullest capacity. Mr. Volk gained the gold medal at the Brighton Scientific Exhibition and Health Congress in 1881.

Mr. Volk has contributed several series of articles to *The Electrician*, among which may be mentioned those on Telephony and on Electric Bells. A notice of his electric dog-cart in a German paper brought him under the notice of H.M. the Sultan of Turkey, who invited him to Constantinople, and gave him a special decoration for applied science, and entrusted him on his return with important commissions. In conjunction with others he obtained an Act of Parliament during the last Session for constructing an electric railway along the seashore between Brighton and Rottingdean, which is now being constructed, and which will, when finished, form a unique addition to our electric railways.

VYLE, Samuel. Born at Hatch-Beauchamp, near Taunton, Somersetshire, in 1842. Educated at various country schools in Somersetshire, and the Wesleyan Training College, Bristol.

In 1860 Mr. Vyle entered the Bristol office of the Electric and International Telegraph Company as learner, and shortly after his appointment there he was removed to Swindon, one of the principal testing stations between Bristol and London. Manifesting an interest in the work, Mr. Culley advanced him to Reading, which he left in 1864 for Edinburgh, but on the engineering staff. During his stay in Scotland he extended the wires from Drem to North Berwick, where Lord John Russell was staying at that time. When the news of the somewhat sudden death of Lord Palmerston became known, Mr. Vyle, by special request, sent and received a number of State telegrams for the Earl. The climate being too severe, he was obliged to go South again, and in 1865 Mr. Vyle was busy renewing the lines between Bath and Weymouth, damaged by the great snowstorm the year before. Subsequently he spent about eighteen months in the District Superintendent's office at Bristol, leaving it for the relay station at Haverfordwest, where he remained till shortly after the transfer of the telegraphs to the Government in 1870. Being a skilled shorthand writer, Mr. Vyle's services were sought by Mr. W. H. Preece to assist him in the heavy correspondence consequent upon the many extensions and alterations then demanded. He volunteered for service during the strike in Ireland, and was sent to Cork. Shortly after his return he went a second time to Scotland, but with headquarters at Glasgow. His section extended from Carlisle to Perth, as also the Trossachs and Helensbro'. He rebuilt the road-line Glasgow to Falkirk, and laid new underground wires at Helensbro' during his stay. He also had the honour of running a special wire for the use of Her Majesty between Fort William and Inverlochie Castle—at the foot of Ben Nevis—under circumstances of considerable stress and difficulty. By working through the whole night, the leading-in wire was entrenched below the carriage drive just three hours before the Royal carriages passed over it. In 1877 Mr. Vyle was permitted to return to England, with Middlesboro' as the headquarters of the Cleveland district. Telephones having come into use, he there carried out a series of experiments for the engineer-in-chief, Mr. Graves. Having rendered special assistance to Messrs. Hammond and Co., after the Town Jubilee Exhibition of the Electric Light, Mr. Vyle was induced to accept the appointment of electrician to that firm, thus severing his connection with the Postal Telegraph Department after a service of 21 years. Engaged with electric lighting and telephonic work in Yorkshire and other provincial centres, he came to London in 1882, and during the two following years was engaged with electric light and telephonic work. In 1884 he joined the Telegraph Department of the Caledonian Railway Company, and for the third time went to Scotland. He carried out two electric light installations there, viz., the lighting of the Grangemouth Docks and the Central Station, Glasgow—then the largest railway station installation known. He was also instrumental in duplexing the Glasgow - Carlisle single - needle circuit for the Railway Company. In November, 1887, Mr. Vyle was appointed by the Secretary of State to the post he now occupies, viz., that of electrician to the Post Office, British Guiana. The small telephone exchange, with Ader instruments, which he found in use on taking charge, was, in August, 1890, replaced by a 200 wire multiple switchboard, and Bell and Blake instruments. Early in June, 1892, Mr. Vyle was enabled to put the town of Bartica (the Gate of the Gold Fields) in telegraphic communication with Georgetown. Bartica is 40 miles up the Essequibo River, the banks of which are so thickly covered with brush as to make a land line impracticable. The connection is made by means of a cable running in the bed of the river. The instruments on the circuit are D.C. Duplex Morse, and the line is now one of the best paying in the colony. Mr. Vyle has written a few technical papers one of which was read before the British Association at York in 1881; and he has repeatedly lectured, with acceptance, both in England and Demerara. In 1880 he invented a new form of lightning conductor which could be easily tested, and his efforts at magneto working of telegraph lines have met with success in a dual working instrument, based on the principle of the reversibility of the dynamo. It has worked well over long lines and high resistances, and it is hoped it will replace the present permanent current working of the telegraphs of the Colony.

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WALKER, Sydney F. Born February 2, 1852; was educated at Christ's Hospital, Newgate-street, E.C., and Hertford, where he was fortunate enough to secure all the prizes in the Mathematical School, including the Bluecoat Boys' great Vidal prize.

Mr. Walker left Christ's Hospital at Christmas, 1865, being head of the Mathematical School then, and passed into H.M.S. "Britannia," training ship for naval cadets. In the training ship he was fortunate enough to gain first of the first-class for seamanship. Subsequently he served in Her Majesty's Navy at various stations, but was eventually allowed to retire on favourable terms. Being free to follow more congenial pursuits, he, after studying for a time in telegraph schools, obtained a probationary appointment on the staff of Sir W. Thomson and Prof. Fleeming Jenkin at Hooper's Telegraph Works, at Millwall, and later in the same year had sole charge of the core-testing at Mitcham. At the latter part of the same year Mr. Walker, in common with many others, was paid off, and was appointed by the Gramme Magneto-Electric Company their electrician. After about fifteen months, however, the Company being hopelessly involved in litigation, he was allowed to resign his appointment, and purchased a small connection that was advertised for sale at Nottingham, and has since gradually succeeded in establishing one of the largest connections among mines in the kingdom. In 1882 Mr. Walker entered into partnership with Mr. F. G. Olliver.

Mr. Walker is a member of the Inst. of Mechanical Engineers; Assoc. M.I.C.E.; member of the North of England Institute of Mining and Mechanical Engineers, of the South Wales Institute of Engineers, and of the Mining Institute of Cornwall; was elected one of the original Fellows of the Imperial Institute; and has been awarded two silver medals from the Mining Institute of Cornwall for electric signals for mines. The firm have also had large experience in the electric lighting of mines, and have applied telephonic communication to the mines and some of the principal buildings in their district. They also hold many patents having relation to electric lighting; and Mr. Walker has recently patented a simple automatic cut-out (electromagnetic) for electric light and power circuits. Mr. Walker is a frequent contributor to technical literature.

In August, 1889, Mr. Olliver retired from the firm, leaving Mr. Walker sole proprietor of the business. About the same time Mr. Walker published a practical handbook, entitled "Electricity in Our Homes and Workshops," dealing with the construction and maintenance of electric bells, mining signals, and telephones, and the book was so well liked that a second edition was called for in four months. At the end of 1891 he published "How to Light a Colliery by Electricity," and in the spring of 1892 "Electric Lighting for Marine Engineers," both of which have sold well.

WALMSLEY, Prof. Robert Mullineux, D.Sc. (Lond.), F.R.S.E., M.I.E.E., &c. Born in Liverpool.

Dr. Walmsley was educated first at a private school, and then at Queen's College, Liverpool. After a period spent in mercantile pursuits in Liverpool, he took up more congenial work in science and education. His university career commenced in 1879, when he passed the matriculation examination of the University of London, the intermediate examination in science was passed in 1880, and he graduated Bachelor of Science in 1882. During part of this time he was on the staff of the Royal Naval School at New Cross, in the building now acquired by the Goldsmiths' Company for a technical institute. In 1881 he became assistant to Prof. Perry in his technical lecture and laboratory work at the Horological Institute, and in 1882 this engagement developed into one with Profs. Ayrton and Perry, during the continuance of which he had charge of the testing of their well-known early forms of electrical measuring instruments. When the Finsbury Technical College was opened in February, 1883, Mr. Walmsley was appointed Senior Demonstrator under Prof. Ayrton in the department of Electrical Engineering and Applied Physics, and this position he continued to hold when Prof. Ayrton was appointed Professor at the Central Institution. He graduated Doctor of Science in the University of London in 1886, taking as his diploma subject Electricity and Magnetism, treated both mathematically and experimentally. In November of the same year he was appointed Principal of a new Technical College that was to be founded in Karachi, India, and proceeded to take up his appointment. On reaching India he found that, owing to some error in the instructions, the college had been wrongly described, and was to be, in the first instance, an Arts College, its technical development being in the distant future. At the time, however, a scheme was under consideration for the founding of a large Technical Institute in Bombay, and Dr. Walmsley remained more than a year in India in the hope that substantial work in the form of technical education might be done there. During this year, whilst Principal of the Sind Arts College of the University of Bombay, he was repeatedly consulted by the Government of Bombay on the subject of the development of technical education in the Presidency, and submitted various schemes to Government embodying his ideas on the subject. Eventually, being convinced that the proposed Victoria Jubilee Technical Institute had neither the financial nor moral support necessary to give it the barest chance of success, he returned to England. In May, 1888, he was appointed Senior Mathematical Lecturer and Demonstrator under Prof. Henrici at the Central Institution, and held this appointment till September, 1889, when the pressure of other engagements necessitated his resignation. Early in 1890 he was appointed the first Professor of Electrical Engineering and Applied Physics in the Heriot-Watt College, Edin-

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burgh. He is a member of the Institution of Electrical Engineers, a Fellow of the Chemical Society, and a member of the Physical Society. He partly revised and extended the last edition of Dr. Urbanitzky's "Electricity in the Service of Man," and has just completed a thorough revision of the same book for a new edition. He also assisted in the translation and extension of Guillemin's "Electricity and Magnetism." At the request of the Council he read a Paper on the "Electrical Exhibits at Edinburgh" before the Institution of Electrical Engineers on the occasion of its visit to Edinburgh in 1890. He is a Sub-Examiner of the University of London, and was elected a Fellow of the Royal Society of Edinburgh in 1891.

WALTENHOFEN, Dr. Adalbert von. Born in Styria, May 14, 1828.

Dr. Waltenhofen studied at the University and at the Polytechnic Institution at Vienna. In the first period of his public career he was assistant to the Professors of Mathematics and Physics in the University of Graz, in Styria. In that University he also obtained the degree of Doctor of Philosophy. He was then engaged to teach mathematics and physics in the Gymnasium and in the Polytechnic Institution, "Joanneum," in that town. Soon afterwards Dr. Waltenhofen was appointed Professor of Natural Philosophy in the University of Innsbrück, in Tyrol, where he at first established a physical laboratory, and remained (1853-1867) until he was appointed Professor of Physics in the Technical High School at Prague. In that position he also established a physical laboratory, and introduced lectures on electrotechnics (1880). He also delivered lectures for telegraph officers, and in the telegraph office at Prague he had the opportunity of practising the methods of testing underground cables and overland wires.

In the year of the Vienna International Electrical Exposition (1883) Dr. Waltenhofen was charged by the Government with the establishment and organisation of a school for electrical engineering connected with the Technical High School at Vienna. Since that time he has been Professor of Electrical Engineering and Director of the Vienna Electrotechnical Institution. Dr. Waltenhofen is correspondent of the Imperial Academy of Sciences at Vienna, member of the Bohemian Royal Society of Sciences at Prague, and honorary member of the Physical Society of Frankfort. He has exhibited instruments and apparatus of his own invention in the South Kensington Exhibition at London (1876), and in the Electrical Exhibitions at Paris (1881), Munich (1882), Vienna (1883), and Frankfort (1891). He gained a diploma for his exhibit at the Paris Exhibition, and for some time he was at work in the testing department of the Munich Exhibition. In the years 1883, 1886, and 1889 he was sent by the Government to visit the technical schools in Germany, especially with respect to arrangements for electrical purposes. Since 1889 he has been President of the Internationale Electricitäts-Gesellschaft in Vienna. He was elected an honorary member of the Frankfort Electrical Exhibition in 1891. Dr. Waltenhofen has published many Papers in the *Reports* of the Vienna Academy of Sciences, in the *Annals* of Poggendorff and Wiedemann, and in the German electrotechnical journals. The most important of these Papers deal with the following matters:—"On the Electromagnetic Properties of Steel (1863);" "On an Anomalous Magnetisation of Iron (1863);" "Researches on the Electromagnetism of Iron (1865, 1870);" "On the Limits of Magnetisation of Iron and Steel (1869);" "On the Electromagnetic properties of Iron Filings and Iron Powder (1870, 1879);" "Electromagnetic Balance, showing by a Striking Experiment the Different Magnetic Properties of Soft Iron Tubes and Solid Cylinders (1870);" "A New Method of Measuring the Resistance of a Voltaic Cell (1868);" "Discovery of the Inversion of Lullin's Experiment (1866);" "Discoveries concerning the Perforation of Glass by Means of Electric Sparks (1866, 1879);" "On Testing and Calculating the Efficiency of Electromagnetic Machines Driven by Voltaic Batteries (1867, 1868);" "On the Electromotive Force of Daniell's Cell (1868, 1884);" "On the Portative Force of Electromagnets (1870, 1885);" "On the Limits of Lenz and Jacobi's Law of Magnetisation (1871);" "On the Thermo-Electric Piles of Noë (1871, 1872, 1877);" "Discovery of a New Phenomenon to be Observed in the Asymmetrical Thermo-electric Piles (1877, 1883);" "On the Firing by Means of Electric Sparks at Great Distances;" "Experiments made on Telegraph Lines between Prague and Vienna (1876);" "Pendulum Apparatus, Showing a Striking Effect of Foucault Currents (1883);" "On the Characteristic Curves of Deprez and Hopkinson (1885);" "Researches on the Efficiency of Storage Batteries, made by Farbaky and Schenek (1886, 1887);" "On New Useful Formulæ for Calculating the Power of Electromagnets (1886, 1887);" "On the Thermal Waters of Gastein (1885);" "Remarks on Dr. Frölich's Theory of Dynamo-Electric Machines (1886, 1887);" "General Rules on Ring and Drum Armatures (1887);" "Reports and Remarks on Storage Batteries (1888);" "On Determining the Efficiency of Accumulators (1888);" "On the Tudor Accumulators (1889);" "Insulation Measurements at the new Court Theatre at Vienna (1889);" "On the Theory of several Formulæ used for Electromagnets (1889)." Dr. Waltenhofen has also written the following books:—"Outlines of Mechanical Physics (1875);" "On the Electrical Units," second edition (1892); "On Lightning Conductors (1890);" and many articles in "Karmarsch and Heeren's Technological Dictionary."

WARD, George Gray. Born at Great Hadham, Hertfordshire, December 30, 1844. Educated at a private school at Cambridge.

Mr. Ward developed a taste for telegraphy at the age of ten, and received a prize for his knowledge of the art. On leaving school he entered the Electric Telegraph Company, and after passing through the various grades of the

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service at different stations, resigned in 1865, and joined the Egyptian Government Telegraph Service, and was stationed for about three years at Alexandria. Mr. Ward was one of the few who stuck to his post during the cholera of 1865, and his valuable services rendered to the Government at that period were specially acknowledged by Ismael Pacha, the late Viceroy. Finding the field for advancement was not very large in that service, he resigned, and accepted a position with the first French Atlantic Cable Company (1869), and was selected to accompany the "Great Eastern" as a member of the electrical staff during the laying of the cable. Mr. Ward was stationed at St. Pierre-Miquelon, and remained there five years. In 1874, owing to ill health, he resigned his position and returned to England. He afterwards joined the Direct United States Cable Company as Superintendent, and organised that company's system in the United States, making his headquarters in New York. Previous to the advent of the Direct Cable it was considered a great feat to receive an answer to a cablegram from London inside of thirty or forty minutes. Mr. Ward so improved the service that he reduced the time to a minimum, and it is now an everyday occurrence to receive replies in less than five minutes. He made the Direct Cable Company very popular, not only with the public but with the Press. In 1884 he accepted the post of secretary and general manager of the Commercial Cable Company. In 1890 he was relieved of the position of secretary, and elected vice-president of the Company, and in this position those qualities of sound generalship which have characterised Mr. Ward's connection with the Commercial have enabled him to achieve great successes in the interests of the cabling public by perfecting an up to date, unique transatlantic service, whilst his urbanity, consistent impartiality, and tact in the administration of the Company's internal affairs, have merited the confidence and affection of the many members of the Company's staff. Mr. Ward's skill and diplomacy have more than once brought delicate and important negotiations entrusted to him to a successful issue. His relations with the officials of the telegraph companies of America and Europe, whether opposed to his company or not, have always been most pleasant. Mr. Ward is Honorary Secretary and Treasurer of the Institution of Electrical Engineers in the United States.

WEBB, Francis Hughes. Born in London, December 8, 1824. Educated at University College School, and the École Normale, Brussels.

Mr. Webb was two years in Germany with John Player, C.E., engineer to the British Nassau Iron Company, and was afterwards appointed clerk in the audit office of the London, Brighton, and South Coast Railway, with the promise of the first vacancy in the Engineer's Office. In 1844 Mr. Webb obtained the appointment of resident secretary and librarian to the Royal Institute of British Architects, which he resigned in 1850 in order to enter the service of the Electric Telegraph Company as assistant to Mr. Edwin Clark, then engineer-in-chief. The following year he accepted the appointment of private secretary to the Chairman of that Company, the late John Lewis Ricardo, M.P., who was interested in various other large undertakings, and with whom he remained until the year of that gentleman's death, 1862, and on whose behalf he had to carry out many important negotiations. During that period he was brought much into communication with the late Robert Stephenson, George P. Bidder, and Messrs. Peto and Brassey; and the latter firm appointed him as confidential auditor on their various works at home and abroad. In 1865 he again entered the service of the London, Brighton, and South Coast Railway as assistant secretary, which appointment he resigned in 1867, and renewed his association with Mr. Edwin Clark, then largely engaged in engineering work. Mr. Webb was secretary to the Nova Scotia and New Brunswick Railway Company, the Malta Hydraulic Dock Company, and the Montevideo Harbour Improvements Company.

In 1878 he was appointed secretary to the Society of Telegraph-Engineers, the duties of the office not then necessitating his relinquishment of the other appointments which he held at the time; but in 1885 the Council found it necessary (owing to the growth of the Society) that he should devote his entire attention to the Society's affairs, including the editing of the *Journal*. The Society—now the Institution of Electrical Engineers—has considerably more than doubled its number of members since Mr. Webb's appointment as secretary, and it is certainly not too much too say that this result is largely due to his exertions.

WEBB, Frederick Charles. Born on the 1st of October, 1828, at 14, Surrey-square, Old Kent-road, London, S.E.

Mr. F. C. Webb is the son of the late Mr. George Webb, formerly secretary to the committee of the London Stock Exchange. He received his early education at a private school at the Mansion House, Hammersmith, being afterwards placed at the Ecole Normale, at Brussels. Having learned French there, he afterwards studied geometry, trigonometry, and navigation under M. Verhaart, professor of mathematics at the School of Navigation at Ostend; was placed for two years at the establishment of the Rev. Edward Jenkins (Chaplain to the King of the Belgians), at Brussels, where, amongst other subjects, he learned free-hand drawing and water colours, mechanical drawing, and fortification. At the age of fifteen he joined H.M.S. "Porcupine," a surveying ship, commanded by Capt. Frederick Bullock, R.N., but held no position in the Navy (except for a short time when he was rated as clerk's assistant), the object being to qualify him as a marine surveyor, so that on his obtaining a naval cadetship, which Captain Bullock hoped to procure for him, he might at once receive the extra pay granted to the officers employed as surveyors. He was thus engaged for two years doing duty

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as a surveying officer, &c. During the two years he was in H.M.S. "Porcupine" the survey known as "The Downs," which includes the Goodwin Sands, was completed, and the freehand sketches of the leading marks, &c., were done entirely by Mr. Webb. He was also present at the erection of one of Captain Bullock's safety beacons on the Goodwin. The survey of the "Approaches to Harwich" was also completed whilst he was in the "Porcupine." Having waited and worked patiently for two years without pay, and not having sufficient interest to obtain a cadetship, he at last gave up the attempt, and the railway mania of 1845 breaking out, he left the "Porcupine," and, under Mr. John Player, was engaged on the levels for the London, Newbury, and Bath Direct Railway. He was then placed with Mr. James Walker, of 23, Great George-street, Westminster, engineer to the Admiralty, Trinity Board, Commercial Docks, &c., and was in that office grounded in all the duties of a civil engineer, such as drawing, tracing, taking out quantities, estimating, &c., and during the time he was with the firm the works in hand were the improvement of the Bedford Level drainage, the Admiralty Pier at Dover, the harbour of refuge at Alderney, St. Helier's Harbour, improvement of Dover Harbour, improvement of Kurrachee Harbour, a new lantern to Eddystone Lighthouse, and other work. A particular manner of placing the supports of the roof, suggested by Mr. Webb, was approved and adopted on the Eddystone and in several other lighthouses. He took the soundings for the contract drawings of the Admiralty Pier at Dover, and for the harbour of refuge at Alderney. Mr. Webb soon afterwards joined the Electric Telegraph Company, under Mr. Edwin Clark, and became engaged almost solely in telegraph work, and executed the following: — The making of a complete set of surveys of the London street wires, of which no record had previously been kept; the erection of two wires between Brighton and Newhaven; six wires between London and Peterborough, and two on to Grimsby; some ten wires on the North London Railway; the surveys of the Lancaster and Carlisle, Maryport and Carlisle, and Stour Valley Railways. In 1853 the Electric Telegraph Company determined to lay cables to Holland, and Mr. Webb was appointed assistant engineer to the International Telegraph Company, and was engaged on the laying and repairing of these cables and the Irish cables till 1857. To carry out this work the Electric and International Telegraph Company purchased the "Monarch" paddle-wheel steamer, of about 500 tons, and she was fitted in 1854 with the first single-drum picking-up machine made, designed by Mr. E. Clark and Mr. Webb, improvements on which are embodied in the more recent machines now in use. Mr. Webb was engaged as one of the four engineers for the first expedition (in 1857) to lay an Atlantic cable, and and in 1858 he was engaged in laying cables in the Mediterranean. In 1859 he was engaged on the experiments made at Gloucester-road for the joint committee appointed by the Board of Trade and the Atlantic Telegraph Company, and during this time had the honour of showing to Faraday the "coil current," or, as it was for some time called, "Webb's current." He also tested and reported on the 1858 Atlantic cable as regards the distance of the fault. His report showed how the resistance of the fault could be roughly ascertained by the *change in its resistance* caused by sending a negative current after sending a positive, which has since received the attention of many electricians. In the same year he was deputed by the Directors of the Red Sea and India cable to test the sections between Aden and Kurrachee, and received on his return the thanks of the Board for "his full and interesting report." In January, February, and March, 1861, he was engaged in the "Resolute" tug in trying to repair the Emden cable. In 1863 and 1864 he was engaged under Messrs. Bright and Clark on the first Persian Gulf cable, and afterwards he was engaged by the Indian Government to remain out for one year in "engineering charge of the line," to teach the staff to repair the cable, to complete some of the work, and to design proper premises for the storage and repair of the recovered cable. These works were carried out by Capt. Mereweather, R.E., and have given entire satisfaction. Mr. Webb came home from India in 1865. In 1867 he had charge, on the part of the contractors (the India Rubber, Gutta Percha, and Telegraph Works Company), of laying a cable from Havanna to Key West (Florida), and from Key West to a lonely place called Punta Rossa, 120 miles up the Gulf of Mexico. In 1868 he was engaged in fitting out the ships for the second Persian Gulf cable, recovering sixty miles thrown overboard from the "Calcutta," and taking all the rest of the cable out and reshipping it, and received the thanks of his Excellency in Council the Governor of Bombay. Mr. Webb, for the India Rubber Company, laid the Post Office cable between Holyhead and Howth, and received Lord Spencer, the Lord-Lieutenant, on board the "La Plata." He also for the same company acted as second to Sir S. Canning in laying the Marseilles and Algiers cable, and repaired it, and recovered the whole of the cable laid during the Franco-German war between Cherbourg and Dunkerque. He laid the Direct Spanish cable between Bilbao, in Spain, and the Lizard, and repaired it two successive years. He also laid the Marseilles and Barcelona cable, and diverted the Direct Spanish cable during the Carlist war from Bilbao to Santander. In 1874 he was engaged by Messrs. Siemens Brothers to command an expedition to complete the Platino-Braziliera cable, and recover 170 miles of cable out of the wrecked steamer "Gomos," and was then made a Knight Officer of the Imperial Order of the Rose by H. I. Majesty the Emperor of Brazil, whom he had the honour of entertaining on board the "Ambassador." This was the last work he executed, but he was afterwards consulted by the Indian Government on the third Persian Gulf cable. In 1877 he was appointed electrician to H.M.S. "Vernon," the torpedo school ship; but his health failed him, and he had to relinquish the appointment, which

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was never again filled up. He is probably the only member of the Institution of Civil Engineers who has been entitled to R.N. after his name. Mr. Webb is the author of a Paper "On the Practical Operations Connected with Paying-Out and Repairing Submarine Cables," which was read at the Institution of Civil Engineers, on the 23rd of February, 1858. He is also the author of several articles in the *Philosophical Magazine*, and of a narrative entitled "Up the Tigris to Bagdad." Some of his articles in *The Electrician* (old series) were republished in book form, under the title of "A Treatise on Electrical Accumulation and Conduction." In these articles he showed that induction takes place in a circuit which he has termed "the inductive circuit." He contributed to *The Electrician* a series of articles on "The Voltaic Circuit Geometrically Illustrated," and another series detailing some of his experiences in submarine telegraph engineering, entitled "Old Cable Stories Retold." He patented a means of preventing the teredo from attacking the gutta percha of submarine cables, and showed how the ordinary sextant may be made to take larger angles. Several of these instruments, which were certified at Kew Observatory as taking 163 degrees, were made, and one was taken by Captain Charles Bullock, R.N., on his survey in Japan, as Captain Bullock perceived and declared that the improvement was of immense importance. He was made an associate of the Institution of Civil Engineers in 1857, and promoted to membership in 1868, and on November 26th, 1884, was by the Council, in consideration of the services rendered by him to the Institution, and of his long connection with it, enrolled as a life subscriber.

WEBB, Herbert Laws. Younger son of F. C. Webb. Born in London in 1864. Educated at private schools and at University College School, London.

Mr. Webb left school in 1880, and in the same year made acquaintance with practical electrical work in the expedition sent out by the India-Rubber, Gutta-Percha, and Telegraph Works Company to lay the third Marseilles-Algiers cable. Afterwards he had charge for some time of some chemical experiments at the paper mills of Messrs. John Dickinson and Co. Having a hereditary bent for submarine cable work, he joined the Silvertown Company again in 1881, and served on the expedition that laid the extensive system of cables of the Central and South American Telegraph Company. For the Telegraph Construction and Maintenance Company he accompanied the expedition that laid the third Red Sea cable, in 1883, and later in that year he went back to the Silvertown Company to take part in the work of laying the Spanish National cables between Spain and the Canary Islands. Mr. Webb has treated of submarine cable work in several Papers and articles, among them one written specially for Messrs. Scribners, and included in their book entitled "Electricity in Daily Life." After several years in the service of the Spanish National Submarine Telegraph Company, during which time he also, with his partner (Mr. Wilson), conducted a general electrical contracting business, Mr. Webb went to America, where he turned his attention to telephone work. He was for several years assistant electrician to the Metropolitan Telephone and Telegraph Company, and resigned this position to take the post of Editor of the American journal, *Electricity*. At the present time he is connected with the Metropolitan Telephone Company in a special capacity. Mr. Webb is the author of a simple book on testing, "A Practical Guide to the Testing of Insulated Wires and Cables," of the "Telephone Handbook," which deals with American telephone practice, and of numerous articles and Papers, both practical and popular, on telephony and other electrical subjects. He is a Member of Council of the American Institute of Electrical Engineers, and a Member of the Institution of Electrical Engineers.

WEBBER, Major-General Charles Edmund, C.B., R.E. (Retired.) Born in Dublin, 5th Sept., 1838. Was educated at the Royal Military Academy, Woolwich, and obtained his first commission in the Royal Engineers in April, 1855.

Major-General Webber's war services comprise the Indian Mutiny, 1857 to 1859, and he was attached to the headquarters of the Prussian army in the Austro-Prussian war of 1866. He was employed in Asia Minor in collecting transport for the Abyssinian Expedition. In 1879 and 1880 he was in Zululand, Natal, and latterly in the Transvaal, with the Egyptian Expedition of 1882, employed as Staff-Officer for Telegraphs; present at the battle of Tel-el-Kebir, A.-A. and Q.-M.-General and Director of Army Telegraphs with the Nile Expedition of 1884-5, until invalided in May, 1885, retired from the service with the honorary rank of Major-General in 1885. In 1867 (as a captain) he was attached to the British Commission at the International Universal Exhibition at Paris; superintended the erection of all the buildings undertaken by the Commission, and was in charge of the experiments in heating and lighting carried on in the English test-house. In 1870 he was placed, under the orders of the Postmaster-General, in command of the 22nd and 34th companies of Royal Engineers for service in the Postal Telegraph Department; appointed a Divisional Engineer, first of the Eastern, and afterwards of the Southern Division of the Postal Telegraphs. During the early years of the development of this great service, he was intimately connected with the extension of the system in various parts of Great Britain, and during that time up till 1879, while carrying on the duties of construction and maintenance of telegraphs, as an officer of the Postal Telegraph Department, was instrumental in training in all branches of telegraphy over 300 officers, non-commissioned officers, and soldiers of the Royal Engineers, whose services have since been of value in several military operations. In 1870 and 1871 he and Colonel Bolton originated and founded

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MAJOR-GENERAL C. E. WEBBER.

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the Society of Telegraph-Engineers, of which he has since been either the treasurer or a member of Council, and in 1882 he was elected the president of the year. In 1878 (when a major) he was appointed by H.R.H. the Prince of Wales British juror for telegraph apparatus at the International Exhibition at Paris. In 1881 he was appointed by Her Majesty's Government one of the British Commissioners for the Electrical Exhibition at Paris, and was also one of the members of the International Electric Congress held the same year in Paris. In reward for these services the 3rd Class of the Legion of Honour was conferred on him by the French Government, in common with the other Commissioners, but as a military officer he was not allowed to receive it. He was also a member of the General Council, and of the Jury for the Electrical Exhibition at the Crystal Palace in 1882, and was a member of the Electrical Jury at the Health Exhibition in 1884. Major-General Webber was charged with experiments in connection with prizes, offered by the Society of Arts in 1872, for inventions in apparatus for heating and the utilisation of fuel, and has thrice sat as a member of council of that society. He is the author of several papers in the *Journal* of the Society of Telegraph-Engineers and Electricians, and on many military subjects. He is a Member of the Institution of Civil Engineers, and a Member of Council of the Royal Albert Hall Corporation. He was first managing engineer and director, and afterwards consulting electrical adviser, of the Anglo-American Brush Electric Light Corporations from November, 1885, to July, 1889; is deputy chairman and consulting engineer of the Chelsea Electricity Supply Company, (Limited); was chief engineer of the City of London Electric Lighting Company; and is an original member of the Société Internationale des Electriciens.

WETZLER, Joseph, M.E. Born at Hoboken, N.J., December 6, 1863.

He received his primary education at the Hoboken Academy, where he graduated first scholar. He then entered the Stevens Institute of Technology, where he pursued the four years' course and obtained the degree of mechanical engineer in 1882. He then took up actively the study of electricity, and entered the Weston Works at Newark, N.J., where he passed through all the departments and became thoroughly conversant with the manufacture of dynamo-electric machinery. The state of his health compelling him to seek a less active occupation, he took up the literary branch of electricity, and after a short period on the editorial staff of the *Scientific American*, undertook in January, 1885, the editorship of the *Electrical World*, associated with Mr. T. C. Martin. In April, 1890, Mr. Wetzler was offered the editorial management of the *Electrical Engineer*, in conjunction with Mr. T. C. Martin, and since then his work has been exclusively devoted to the interests of that journal. Besides the innumerable articles from the pen of Mr. Wetzler appearing in the electrical journals, he is also the joint author with Mr. T. C. Martin of "The Electric Motor and its Applications," a pioneer work which has passed through three editions; and with Mr. Martin has recently undertaken the editorship of the electrical department of the new edition of Appleton's "American Cyclopædia of Applied Mechanics.' He also contributed the article on "Electric Railways" to the recent electrical series of *Scribner's Magazine*. Mr. Wetzler is one of the oldest members of the American Institute of Electrical Engineers, has been a member of its Council for a number of years, and recently one of its Vice-Presidents. He was also one of the delegates of the American Institute of Electrical Engineers to the Paris Electrical Congress in 1889. He has also been prominently connected with the New York Electrical Society, and is now its President for the second time.

WHARTON, Charles Joseph, son of the late Rev. C. C. Wharton. Born at Weymouth in 1857; educated at Coventry and Worthing.

Mr. Wharton's attention was first turned to electricity at the great Paris Exhibition, and soon after he commenced experiments with a modification of the Bunsen battery as applied to motors for rock drills in mines and for launch work. Becoming acquainted with the late Count Th. du Moncel, he arranged for the rights of his two works on "Electromagnets" and on "Electricity as a Motive Power," which he published in English. Having secured the London agency of the original Swan Company, he entered into partnership with the late Mr. J. G. Laing, and subsequently, with the assistance of Mr. F. J. Down, the now well-known firm of Laing, Wharton and Down was formed. In 1883 he was asked to revise and edit the English version of M. Hospitalier's "Domestic Electricity," which was soon after published. Meanwhile his firm carried out many important installations, some of them under his direct supervision. In the beginning of 1885 he was delegated by his firm to make a tour in the United States for the purpose of investigating the various systems of arc-lighting in vogue there, and after some negotiations obtained the sole control of the Thomson-Houston system for England. Messrs. Laing, Wharton and Down exhibited this system at the International Inventions Exhibition that year, lighting the east gallery and arcade, with the result that they were accorded the only gold medal for arc-lighting. Since then the firm have carried out many and varied installations, both arc (Thomson-Houston) and incandescent (Edison-Swan), as well as for transmission of power. Mr. Wharton is a member of the Institution of Electrical Engineers, and also was one of the original founders of the Electrical Trades Section of the London Chamber of Commerce.

WHEELER, Schuyler S.

Upon leaving Columbia College in 1881, Mr. Wheeler became assistant electrician of the American branch of the Jablochkoff Electric Light Company. When that company dissolved he joined the United States Electric Light Company, and subsequently left them to

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become a member of Mr. Edison's staff. Mr. Wheeler was present at the inauguration of the Pearl-street Station, was made electrician in charge, and was detailed to lay the underground systems in other cities. He afterwards became superintendent of the Newburgh Edison Company, resigning that position to accept the post of electrician to the Herzog Teleseme Company. Mr. Wheeler subsequently joined the "C. and C." Electric Motor Company as electrician and factory manager. After establishing the factory of the "C. and C." Electric Motor Company, he organised the firm of Crocker and Wheeler, electrical engineers, since incorporated as the Crocker-Wheeler Electric Company, of which he is the president. He is also Electrical Expert to the Board of Electrical Controlof New York, which position he has occupied since the Board was constituted six years ago. He is a member of the American Society of Civil Engineers, the National Electric Light Association, the American Institute of Electrical Engineers, and the American Society of Mechanical Engineers; and has received the honorary degree *Scientiæ Doctoris* for recent original work done in electricity.

WIEDEMANN, Eilhard. Born at Berlin, 1852.

Mr. Eilhard Wiedemann is the son of Mr. Gustav Wiedemann. He was Privat docent at Leipzig, then professor at Darmstadt, and is now professor at Erlangen. His principal Papers are—"On the Elliptic Polarisation of Light when it is Reflected from Bodies with Surface Colours," "On the Specific Heat of Gases and Vapours," "On Electrical Discharges," "On Phosphorescence and Fluorescence," "On the Mechanics of Luminosity." In these researches he has shown that the gases in Geissler tubes may be luminous at temperatures much below 100°C., &c. He is editor of the *Beiblätter zu den Annalen der Physik und Chemie*, and is joint editor with Dr. Ebert of "Physikalisches Praktikum."

WIEDEMANN, Gustav Heinrich, Doctor of Philosophy and Medicine; Professor of Physics at the University of Leipzig. Was born on the 2nd October, 1826, at Berlin, where his father was a wholesale merchant; received his first education at the Gymnasium in Berlin, which was under the direction of August, Professor of Physics, and where a fundamental education was imparted in classical languages as well as mathematics and natural science.

At an early age Prof. Wiedemann commenced his studies when he was eighteen years old at the Berlin University, these being principally directed to physics, chemistry, and mathematics, and he had the good fortune to enter the private laboratory of Magnus, which was only accessible to a few scholars. Under the guidance of this excellent experimentalist (1845-47) he completed his first chemical researches respecting biuret, a derivative of urea, and in 1847 he became Doctor of Philosophy. His inclinations and the continual impulse he received through his intercourse with Magnus soon led him to devote his attention to physics, and as early as the year 1849 he published his researches respecting the electric conducting power of crystals, which were soon followed by other works on the magnetic rotation of the plane of polarisation, electrical endosmose, the coincidence of the conductibility of metals for heat and electricity (the last in conjunction with W. Franz). After marrying the eldest daughter of the celebrated chemist, Eilhard Mitscherlich, Prof. Wiedemann was appointed in 1854 to an ordinary professorship at the University of Basle, whence he went to the technical high schools in Brunswick (1863) and Karlsruhe (1866). In 1871 Prof. Wiedemann undertook the professorship for physical chemistry in the Leipzig University, which he exchanged in 1887 for the professorship of physics at the same place. At this time he followed up the experiments, commenced in 1859 and continued until quite recently, respecting the torsion, flexion, and magnetism, as well as the relations existing between the mechanical and magnetic properties of bodies, by which the complete analogy between them was demonstrated, and the processes that take place in magnetising were referred to the principle of subsequent elastic action (which has been recently termed in England "hysteresis"). He also published a series of researches respecting the magnetic relations of chemical combinations, by which the simple relations existing between chemical combinations and the magnetism of bodies were explained. He also wrote on electric discharges, &c., and made a new determination of the ohm. Moreover, Prof. Wiedemann published, in 1863, a work on galvanism and electro-magnetism, the second edition of which, in three volumes, appeared in 1871; and the third, in five volumes in 1885, under the title "Die Lehre von der Electricität," contains an exceedingly complete and critical treatise on this subject, interspersed with many original and theoretical suggestions. Since 1877 Prof. Wiedemann has edited the *Annalen der Physik und Chemie*, which used to be published by Gren, Gilbert and Poggendorf. Amongst the many academical honours bestowed on Prof. Wiedemann may be named his nomination as foreign member of the Royal Societies of London and Edinburgh.

WILKINS, J. W. Born March, 1827.

Mr. Wilkins began his telegraph career at a very early date. Originally intended for the profession of civil engineer, he commenced a course of practical instruction in the establishment of Mr. Thomas Cubitt, the eminent builder, and after a little less than two years' work there, made a start in engineering. An early *penchant*, however, for electricity, which was fostered at the school he attended in his boyhood, was the basis of his introduction to the telegraph. Mr. Wilkins thereon abandoned all idea of qualifying for any other profession, and entered the workshops of Mr. Robert Reid, telegraph instrument maker, on the understanding with Mr. W. F. Cooke that he should become practically acquainted with the mysteries of electricity as applied to telegraphs with the object of his qualifying himself for

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the superintendence of lines then in contemplation. During the first few months Mr. Wilkins had the opportunity of assisting in the maintenance of the two or three experimental lines then existing, in company with the sons and *employés* of Mr. Reid, and also at times with Mr. Cooke himself, who at that date personally attended to whatever was necessary to be done in the way of keeping the lines in efficiency and order. The Northampton and Peterborough Railway telegraph was the first line considered of sufficient importance to necessitate the presence of a resident superintendent. Mr. Wilkins assisted Mr. Cooke to open this line by July 1, 1845, and remained a few months after, until Mr. Wm. Highton, C.E., who was appointed to the superintendence of the electric telegraph on the "London and Birmingham line and branches," relieved him of his charge. After this Mr. Wilkins practically took over the general superintendence of all the lines that had been erected during the interval of his residence on the Northampton and Peterborough Railway, including Hull on one side of England and Fleetwood on the other, and from Rugby to Newcastle, and the extension that was then being rapidly pushed on toward Berwick-on-Tweed. Very soon, in consequence of the rapid extension of the telegraph all over England, the area of Mr. Wilkins's superintendence narrowed, and on the completion of the line from Rugby to London in 1848, connecting the Metropolis with the rest of England, he was in charge of the line and a temporary terminus for London in Seymour-street, Euston-square. In 1851, accepting a tempting offer to erect telegraphs in the United States of North America for one O'Rielly, who had a general contract with Prof. Morse to erect telegraph lines at a royalty per mile, Mr. Wilkins found soon after his arrival that the principals to the contract were at issue in the matter of the construction by which it was proposed to connect New York with New Orleans. It becoming evident that no work was likely after all to be done for some time, after erecting a line of telegraphs from Boston to Portland, Maine, in 1851, for the "Associated Press" of New York, Mr. Wilkins transferred his services, at Mr. O'Rielly's suggestion and introduction, to the contractors for the Ohio and Mississippi Railroad. From this date (the end of 1852) Mr. Wilkins was engaged in America and over a good part of Europe on public works for the late Thomas Brassey, the well-known contractor, with whom he remained until Mr. Brassey's demise. About 14 years ago, on the occasion of the death of Sir W. Fothergill Cooke, and the appearance about the same time of a Post-Office report of the immense amount of work then done by the telegraph, Mr. Wilkins wrote a short note, which appeared in the columns of the *English Mechanic* for September 5, 1879, under the initials "J. W. W." This letter was noticed by Mr. Latimer Clark, who asked for further information about the "earlier days of the electric telegraph." The information was given in the next number (September 19th). These letters can be referred to by those desirous of learning something of what occurred in telegraph matters before the introduction of gutta-percha, or the incorporation of the first "Electric Telegraph Company" in England.

WIMSHURST, James. Born April 13, 1832; is the second son of the late Mr. Henry Wimshurst, whose name was associated with the introduction of the screw propeller.

Mr. Wimshurst was educated at Stebonheath House, London, at which school he acquired the rudiments of several branches of science. Circumstances made it, however, desirable that he should adopt a business life, and for several years he worked for his father. He then joined the professional staff of Lloyd's Register of Ships, and fulfilled those duties for about eight years. A little later he accepted the chief position with the Liverpool Register of Shipping, when, after ten years' successful work, he received an appointment to a principal position in the Consultative Branch of the Board of Trade, the Liverpool Committee at that time presenting him with a substantial testimonial; and in 1890 he was one of the representatives of the Board of Trade at the International Conference held at Washington, U.S. Most men would have been contented to have run so useful a career, and have availed themselves of the spare hours to enjoy social pleasures, but it was not so with Mr. Wimshurst. From the beginning he had always maintained a well-fitted laboratory, his practical training enabling him to readily put his thoughts into substantial form, and by actual test to determine whether or not to further pursue any subject. In this way photography, chemistry, engineering, electricity, and other branches of study have each obtained a share of his attention, but his work for many years was known only to his most intimate friends. Since 1882, when Mr. Wimshurst published the particulars of a large and very powerful influence machine which he had designed and made, he has continued to perfect various forms of apparatus for the production of large quantities of statical electricity under atmospheric conditions which would be fatal to the working of any other type of instrument. These machines are now well known throughout the world by his name. He has also designed and made a very useful form of mechanical air-pump, which rapidly produces high vacuum, and which, from its design, is absolutely free from leakage, the degree of vacuum being, however, limited to the vapour density of the lubricant used. Mr. Wimshurst's own house affords evidence of his practical and scientific tastes. He has a complete installation for electric lighting, designed and executed by himself and his two sons, while his home collection of apparatus is, we believe, quite unequalled. A notable feature in Mr. Wimshurst's work has been his steady and persistent refusal to accept anything from any source in the nature of pecuniary advantage from his scientific labours. Nearly all the scientific institutions in the country possess his machines,

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while his advice or assistance, based on long experience and wide knowledge, have been always freely at the service of the student and investigator. In 1890 he was given a seat on the Council of the Physical Society, when he introduced a new form of influence machine which produces rapidly-alternating charges of electricity; and he has recently put forward another type of influence machine which possesses many useful features.

WINSLOW, I. E. Born in Brooklyn, N.Y., in 1865. Educated at the Brooklyn Polytechnic Institute.

In 1887 Mr. Winslow entered the employ of the American Electric Manufacturing Company of New York, and installed several arc light plants. After a short time with the Daft Company, in the fall of 1888 he joined the Thomson-Houston Electric Company, and during the time he was employed by them he was chiefly engaged in electric traction work, having installed about a dozen tramway plants with uniform success in various parts of the United States, Canada, and British Columbia. He also installed the Roundhay Electric Tramway at Leeds, and is now again managing it.

WOLCOTT, Townsend. Born in New York, in July, 1857.

Mr. Wolcott worked in his father's shop as a practical mechanic, and in his leisure studied mathematics and science. He has been for some years engaged in the practical applications of electricity, and has experienced the usual ups and downs of a busy life. He had a desire to devote his whole time to pure science, but circumstances decided that this could not be. Mr. Wolcott has been associated with a number of electrical companies, several of which, however, have ceased to be. In 1880 Prof. C. A. Seeley employed him to superintend the construction of a dynamo of his (Prof. Seeley's) invention, known as the "Arago Disc" Dynamo, at the works of Messrs. Lovejoy, Son, and Company, of New York, the machine being used by this firm for electrotyping. From here Mr. Wolcott was transferred to Mr. Weston's laboratory at the United States Electric Company's works at Newark, N.J. He has since been associated with the Sprague Electric Railway and Motor Company, the Julien Electric Traction Company, the Mutual Electric Manufacturing Company, the New American Electrical Arc Light Company, and the Astoria Electrical Manufacturing Company. In 1889 King's College, Nova Scotia, offered him the newly-created Chair of Electrical Engineering, but on account of other engagements he was unable to accept it. Mr. Wolcott once studied Civil Engineering, but, like our worthy fellow-countryman, Herbert Spencer, did not find much encouragement in it.

WOODBURY, C. J. H. Born at Lynn, Mass., and educated in the public schools of his native city, and at the Massachusetts Institute of Technology, where he took the course in civil engineering.

Mr. Woodbury's first important professional engagement was as assistant to boards of engineers in making tests of water-works pumping engines in various eastern cities, beginning in 1873, under the supervision of James B. Francis, C.E., on tests of the first compound pumping engines used in America. In 1878 he entered the employment of the Factory Mutual Insurance Companies as special inspector and engineer. The subjects which especially engaged his attention were lubrication and the fire risks of electric lighting, and automatic sprinklers. In 1885 he received from the city of Philadelphia the John Scott medal "for securing safety in the use of electric lighting in mills." Mr. Woodbury's work has been largely in connection with the interests of the Underwriters of Fire Risks in America. As an engineer he has been consulted on many of the principal light and power installations in the States, as well as upon some British installations, and is a Vice-President of the Boston Manufacturers' Mutual Fire Insurance Company.

ZETZSCHE, Karl Eduard, Doctor of Philosophy. Born in 1830, in Altenburg, Saxony.

Visited from 1851 to 1856 the Polytechnic Schools and the University in Dresden and Vienna, and afterwards took employment in the Austrian Telegraph Service in Vienna, Padua, and Trieste. He went in 1858 to Chemnitz, Saxony, where he became teacher of mathematics and mechanics at the Royal Technical High School, and in 1876 he accepted the chair of Professor of Telegraphy at the Polytechnic School in Dresden. In 1880 he went to Berlin and became editor of the *Elektrotechnische Zeitschrift* (1880-1886) and telegraph engineer to the German Postal Service (1880-1887). He now resides at Dresden, devoted solely to his literary and scientific occupations. He has published several books on geometry, trigonometry, and telegraphy, most of them having had several editions. His latest work is "Der Betrieb und die Schaltungen der elektrischen Telegraphen" (1890 and 1891), which is complete in itself, although forming the second part of the third volume of his "Handbook of Electric Telegraphy" (four volumes). For the fourth volume of this work he and Herr Kohlfurst received in 1881 an honorary diploma at the Paris Exhibition, and in 1882 they were awarded a prize of M.1,500 by the Verein der deutschen Eisenbahnverwaltungen. Dr. Zetzsche is a foreign member of the Institution of Electrical Engineers, member of the Electrical Societies of Dresden and of Austria, of the Saxon Society of Engineers and Architects, of the American Institute of Electrical Engineers, and of other learned societies.

ZICKLER, Charles. Born September 16, 1860, at Karlsbad (Bohemia).

After studying at the Realschule at Komotau (Bohemia), and afterwards at the German Technical High School at Prague, he became assistant at the Staatsgewerbeschule at Bielitz (Moravia). In the year 1884 he was appointed assistant and

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in 1890 engineer at the Electrotechnical Institute newly established at the Vienna Technical High School. In the same year he was also made a Privat-Docent there. In the year 1891 he was appointed professor of electrical engineering at the Technical High School at Brünn (Moravia), where he is charged with the establishing of an Electrotechnical Institute. Herr Zickler is the author of a book on "Electric Firing," and of numerous scientific Papers chiefly dealing with "Electromagnetism" and a new method of calculating and designing dynamo-electric machines. The more important of his Papers are—"On the Curves of Magnetisation of Iron and Steel, and their Relation to Hardness and Carbonisation" (*Centralblatt für Elektrotechnik*, 1886); "On Herr Frölich's Theory of Compound-Wound Dynamos" (1887); "On the Predetermination of Dynamo-Electric Machines of Different Sorts" (1888); "Researches on Electromagnetism with Relation to Frölich's Formula" (1889).

ZIPERNOWSKY, Prof. Charles. Born at Vienna in the year 1853.

Mr. Zipernowsky is the son of a merchant. He was educated at Budapest, where, after finishing the gymnasium, he studied chemistry. He went in 1872 to the Royal Polytechnicum, where he took up the science of mechanical engineering. During the first year of his technical studies he was also employed as a draughtsman in the offices of the Austrian States Railway Company. In 1877 he took the degree of an Engineer, and was privately employed for some months in making electrical apparatus, an occupation he had already begun during the last year of his University scholarship. Since 1878 he has been engaged as an engineer by the firm of Ganz and Co., Budapest, where he made in the same year the first continuous-current dynamo in Hungary, and the first alternating-current dynamo, which is manufactured by the firm in a similar form up to the present time. In 1880 Mr. Zipernowsky made, and took letters patent for, a dynamo with consequent magnet poles producing direct and alternating high frequency and high tension currents, and he has since made a number of inventions in electrotechnics, many of which have attained great popularity. The more important are:—Electrical arc lamp, with variable light power, 1881; a direct, alternating, and differential phase current generator, with one or more circuits, 1881; self-exciting alternating-current dynamo, 1882; a large alternator directly connected to a steam-engine, 1883; rotating secondary generator, 1884; a self-exciting multipolar dynamo, producing direct, alternate and differential phase currents of constant tension or constant quantity, 1884; improved induction apparatus for the transformation of electric currents (transformers), 1885; dynamo compensator, 1885; improvements in distributing electricity (parallel working of transformers), 1885; improvements in regulating alternating currents, 1886; improvements in armatures of dynamos, 1887; improvements in measuring apparatus for electric currents, 1887; dynamo electric brake regulator, 1887; improvements in manufacturing electric accumulators, 1887; improvements in alternating-current dynamos, 1887; method of hardening springs by electricity, 1888; improvements in driving dynamos for the illumination of railway trains, 1888; electric current converting apparatus (from alternating current into continuous, and *vice versâ*), 1888; improvements in distributing electric energy with differential phase currents, 1888; improvements in fittings for electric currents, 1888; improvements in armatures of dynamo-electric machines or motors, 1888; railway with vertical track and conduit, and rolling stock therefor, 1889; improvements in alternating current motors, 1889; conduit mains and contact arrangement for electric railways, 1889; railway switch, 1889; heating and soldering electrically by imperfect contacts, 1890; rolling stock for tramways or railways (motor trucks), 1890; distribution system with alternating and continuous currents by means of rotary converting appliances and accumulators, 1890; system of supplying currents to electric railways and other appliances from central stations, and in connection therewith a new rapid transit electric railroad, 1891; distributing differential phase currents to overhead or underground-conduit electric railways, and to lighting plants, 1891; an active electric wire-obstacle (bar) for military purposes, 1891; a friction clutch, 1892. In some of these inventions he has worked in conjunction with Mr. Déri or Mr. O. T. Bláthy, and in some cases with both these gentlemen. In 1893 Mr. Zipernowsky was elected Corresponding Member of the Royal Hungarian Academy of Sciences, and was in the same year appointed Professor of Electrotechnical Science in the Royal Hungarian Polytechnic Academy in Budapest.

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APPENDIX TO BIOGRAPHICAL SECTION.

Below we give those Biographical Sketches which have been returned to us too late for proper classification; and we take this opportunity of expressing our regret that the gentlemen to whom these sketches refer do not render us that assistance which is so essential in a work of this character. Some of the sketches which follow only reached us in the second week in January, which, as our readers will understand, does not give us an opportunity of including them in the ordinary list. In other cases the sketches have not been returned to us at all; and this will account for the absence of several of the memoirs which have previously figured in these pages.

The Biographical Division of this Annual is, we have every reason to believe, thoroughly appreciated, as a proof of which we refer our readers to the very full memoirs of many leading men of Electrical Science, which have been specially written or revised for this HANDBOOK.

BRUSH, Charles Francis, M.E., Ph.D., Electrical Engineer, Cleveland, U.S.A. Born March 17, 1849.

Mr. Brush is of purely English descent, his parents' families having come from England in 1630 and 1656. In 1862, when aged but thirteen years, Mr. Brush made his first experiments with magnets and batteries; and while at the High School, in 1864, he became much interested in the subject of microscopes and telescopes, making a number of them for himself and his companions. He constructed every part of these instruments, even to grinding the lenses. In the same year he devised a plan for turning gas on in the street lamps, lighting it, and then turning it off again, by electricity. He also constructed a number of induction coils, and greatly amused himself and his schoolmates by experiments with them. Having graduated in a four years' course at the Cleveland High School in two and a half years, and continuing to show a fondness for physics and other studies of a similar nature, he entered the University of Michigan at Ann Arbor, where he took up a course of study particularly suited to his tastes, and by diligent attention to his tasks he graduated as a mining engineer in 1869, being one year in advance of his class. Returning to Cleveland from college, he organised a laboratory and conducted the business of an analytical chemist for about three years, becoming noted for the accuracy of his work and the skill displayed in his manipulation. In the spring of 1873 Mr. Brush formed a partnership with Mr. C. E. Bingham, of Cleveland, for the purpose of handling and marketing Lake Superior and other pig-irons and iron ores. While engaged in this business, Mr. Brush resumed his electrical investigations, and early in 1876 completed his first dynamo-electric machine. This machine was of a distinctly new type, and embodied the first of Mr. Brush's series of inventions. Early in 1877 Mr. Brush closed his partnership with Mr. Bingham, and from that date devoted his entire attention to electrical invention. At that time he also made a contract with "The Telegraph Supply Company," of Cleveland, by the terms of which that Company undertook the manufacture and sale of electric light and other apparatus patented to him, paying him a royalty thereon. In 1881 the name of this Company was changed to "The Brush Electric Company," and its capital stock greatly increased. Early in 1877 Mr. Brush invented and constructed his first commercial arc lamp, and exhibited it in connection with one of his new type of dynamos at the Franklin Institute of Philadelphia, where both pieces of apparatus carried off all the honours, in competition with the other best-known lamps and dynamos of that period. Soon after this Mr. Brush invented his series arc lamp, having a regulating shunt circuit of high resistance. Among Mr. Brush's other inventions of early date may be mentioned his copper-plated carbons for arc lights, his automatic cut-out for arc lamps, his series-shunt winding for dynamo-electric machines, and his multiple carbon arc lamp for all-night burning. The patent covering this important invention has recently been sustained by the United States Courts. Mr. Brush at an early date completed his fundamental storage-battery invention, consisting in the mechanical application of the active material to the electrodes; and subsequently, after four years of constant litigation in the Patent Office, obtained patents therefor. The issue of these patents was followed by nearly four years more of fierce litigation in the United States Courts, which has recently resulted in the complete vindication of his claims, securing to Mr. Brush the honour of this great invention. Mr. Brush may justly be considered the father of

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the arc electric lighting industry of the world. Mr. Brush patented many of his earlier inventions abroad, and in 1880 sold these patents to a London company formed for the purpose of exploiting them, and known as the Anglo-American Brush Electric Light Corporation. He received in payment both cash and stock of the corporation, the subsequent sale of which, together with the cash payment, realised about a half-million of dollars—a price for patents then almost unprecedented. Mr. Brush's house in Euclid-avenue, Cleveland, is very appropriately lighted by electricity, the power being furnished by an enormous windmill located in the park at the rear of the house, and about five hundred feet distant. Mr. Brush is a self-taught mechanic, and is able to do shop work equal to the best trained men. He is intensely practical, and is an excellent business man in the management of his own affairs. Mr. Brush is of excellent physique, being six feet two inches in height, and broad-shouldered in proportion. In 1869 the University of Michigan conferred upon him the degree of M.E. In 1880 the Western Reserve University invested him with the degree of Ph.D.; and in 1881, in connection with the Electrical Exposition held in Paris in that year, the French Government decorated him Chevalier of the Legion of Honour. In 1885 he was elected Fellow of the American Association for the Advancement of Science.

COCKBURN, Arthur C., F.C.S., M.I.E.E. Born at Richmond, September 19, 1859; educated chiefly at Harrow.

After leaving Harrow, he became an articled pupil to an architect and surveyor, serving his time and assisting in carrying out the erection of many important buildings. During this period he developed a natural taste for the sciences, and spent the whole of his spare time in studying the various branches, and obtaining numerous certificates from the Kensington Science and Art Department. This led to his architectural profession being given up, and after two years' further study he obtained an assistantship in the Physical Section of the Science Department of the Harrow School. He occupied this post for two years, when he resigned to take up the study of analytical chemistry and research work, at the renowned laboratory of Dr. John Muter, M.A., F.C.S., at Kennington Oval. From thence, in February, 1880, he obtained the post of Demonstrator in the Electrical Engineering Department of the Finsbury Technical College, under Prof. Ayrton, and afterwards under Prof. S. P. Thompson, covering a period of eight years. In the early part of this appointment he took an active part in furthering the development of the scheme for technical education, and largely assisted in designing the fittings for the present college. In the same year of his entry to the college (1880) he was elected Fellow of the Chemical Society and member of the Society of Telegraph Engineers. In 1887 Mr. Cockburn invented the now well-known Cockburn Patent Cut-Out, or Safety Fuse, reading a Paper on the same before the Telegraph Engineers, which Paper obtained the Society's premium for that year; after which, in connection with Mr. E. Thomas, he brought out the Cockburn-Thomas "Lock-Switch."

At the end of the year 1888 Mr. Cockburn resigned his position at the Finsbury College to enable him to accept the managership of the Acme Electric Works, which he left in August 1890, to enter the firm of Messrs. D. Hulett and Co. as manager of their electrical department. In 1889 he was elected life member of the Physical Society of London.

CROSBY, Oscar T., is a native of Louisiana, where he was born 30 years ago, and passed most of his boyhood in Brookhaven, Miss. From there he entered the U.S. Military Academy in 1878, and four years later graduated second in rank in a large class.

On graduation, Mr. Crosby was commissioned as an officer in the engineer corps, and was stationed at Willetts Point, N.Y., where the torpedo system of the United States service has been developed. After two years spent in the study of this and other problems in military engineering, Lieutenant Crosby was sent to New Orleans for river and harbour duty. He remained at that station for two years engaged in planning and executing various works of improvement. In May, 1887, he obtained six months' leave of absence, and soon after resigned and joined the Sprague Railway and Motor Company in time to take an active part in the early development of electrical traction. He soon assumed the duties of superintendent of the company, and in that capacity was in charge of its manufacture and installation departments. He remained in the service of the Sprague Company for two years and a half, and in the course of his professional work executed various researches on the problems involved in electric railroading. With the advantage of the splendid training acquired by these years of investigation and experience, he undertook the engineering of the Weems Electric Railway Company, and has fully reported to the American Institute of Electrical Engineers the interesting results attained at speeds reaching 120 miles per hour. In December, 1890, Mr. Crosby accepted the position of general manager of the Railway Department of the Thomson-Houston Electric Company, with headquarters in Boston, Mass., U.S.A. Since the organisation of the General Electric Company, by the consolidation of the Edison General Electric Company and the Thomson-Houston Electric Company, Mr. Crosby has been general manager and also head of the Power Transmission Department of the General Electric Company. He wrote, as associate author with Dr. Louis A. Bell, "The Electric Railway in Theory and Practice," published in December, 1891, and which has been well received in this country as well as in America. In connection with Lieut. Ruckman, Fifth U.S. Artillery, he also developed the Ruckman-Crosby Range and Position Finder, which has been adopted by the Board of Ordnance and Fortifications of the United States.

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HICKS, William Mitchinson, Sc.D. (Cantab), F.R.S. Born in Launceston, Cornwall, in 1850.

Mr. Hicks entered St. John's College, Cambridge, in October, 1869, and graduated 7th Wrangler in 1873. After taking his degree he worked under Clerk Maxwell in the recently established Cavendish Laboratory, being one of the first students there. He was elected Fellow of St. John's College in 1876. He resided in Cambridge until 1883, when he was appointed Principal of, and Professor of Mathematics and Physics in, Firth College, Sheffield. On the separation of the two chairs in 1892 he continued to hold the Professorship of Physics, in connection with which he has organised a department for Electrical Technology. He has published several papers, which have appeared in the *Philosophical Transactions*, *Philosophical Magazine*, *Quarterly Journal of Mathematics*, the Reports of the British Association, and other publications. He is also the author of an elementary treatise on Dynamics, now in the third edition.

JONES, John Viriamu, M.A. (Oxon.), B.Sc. (Lond.), Principal and Professor of Physics in the University College of South Wales and Monmouthshire, Cardiff, was born at Pentreporth, near Swansea, in 1856.

Mr. Jones in 1872 passed the matriculation examination of the University of London, being placed first in the Honours division. He then entered University College, London, and graduated Bachelor of Science in 1875, taking the University Scholarship in Geology. In 1874 he obtained a Brackenbury Scholarship in Natural Science at Balliol College, Oxford; in 1877, a First Class in Mathematical Honours in Moderations; in 1879, a first class in the Final Honour School of Mathematics; and in 1880, a first class in the Final Honour School of Natural Science (Physics).

In 1880, he was appointed Demonstrator in the Clarendon Laboratory, Oxford, under Prof. Clifton. In 1881, he became Principal and Professor of Mathematics and Physics in the Firth College, Sheffield; and in 1883, he was elected Principal and Professor of Physics in the newly founded University College of S. Wales and Monmouthshire at Cardiff. Prof. Viriamu Jones is the author of several papers, contributed to the *Transactions* of the Royal Society, the Physical Society, and the British Association, among which, the more important relate to the absolute measurement of electrical resistance, and points connected with it. He is a Fellow of University College, London; a Member of the Royal Institution; a Member of the Council of the Physical Society, and a Member of the British Association Committee for the Determination of Electrical Standards. He has been closely connected with the rapid development of University and Technical Education in South Wales and Monmouthshire.

QUINCKE, Georg. Professor of Physics in the Heidelberg University. Born in Frankfort-on-the-Oder in 1834.

From 1852 to 1858 Prof. Quincke studied in Berlin, Königsberg, and Heidelberg. He took his degree of Doctor of Philosophy in Berlin in 1858; was Lecturer and Assistant-Professor of Physics in the Berlin University from 1859 to 1872; was at the Gewerke-Akademie in Berlin from 1860 to 1872; teacher of chemistry and physics in the Berlin Bau-Akademie from 1862 to 1865; Professor of Physics at the Würzburg University from 1872 to 1875; and since 1875 he has been Professor of Physics at the Heidelberg University. Prof. Quincke is a Fellow of the Royal Societies of London and Edinburgh, an honorary member of the Physical Society of London, of the Philosophical Society of Glasgow, of the Manchester Literary and Physical Society, of the Cambridge Philosophical Society, &c. He has contributed some twenty memoirs to *Poggendorff's Annalen*.

VYLE, Samuel (p. CII.).

It should be mentioned that the telephone exchange at Georgetown, British Guiana, is now supplied with a 400-wire multiple switchboard, and that Mr. Vyle has fitted up an exchange with a 100-wire switchboard at New Amsterdam, some 70 miles from Georgetown.

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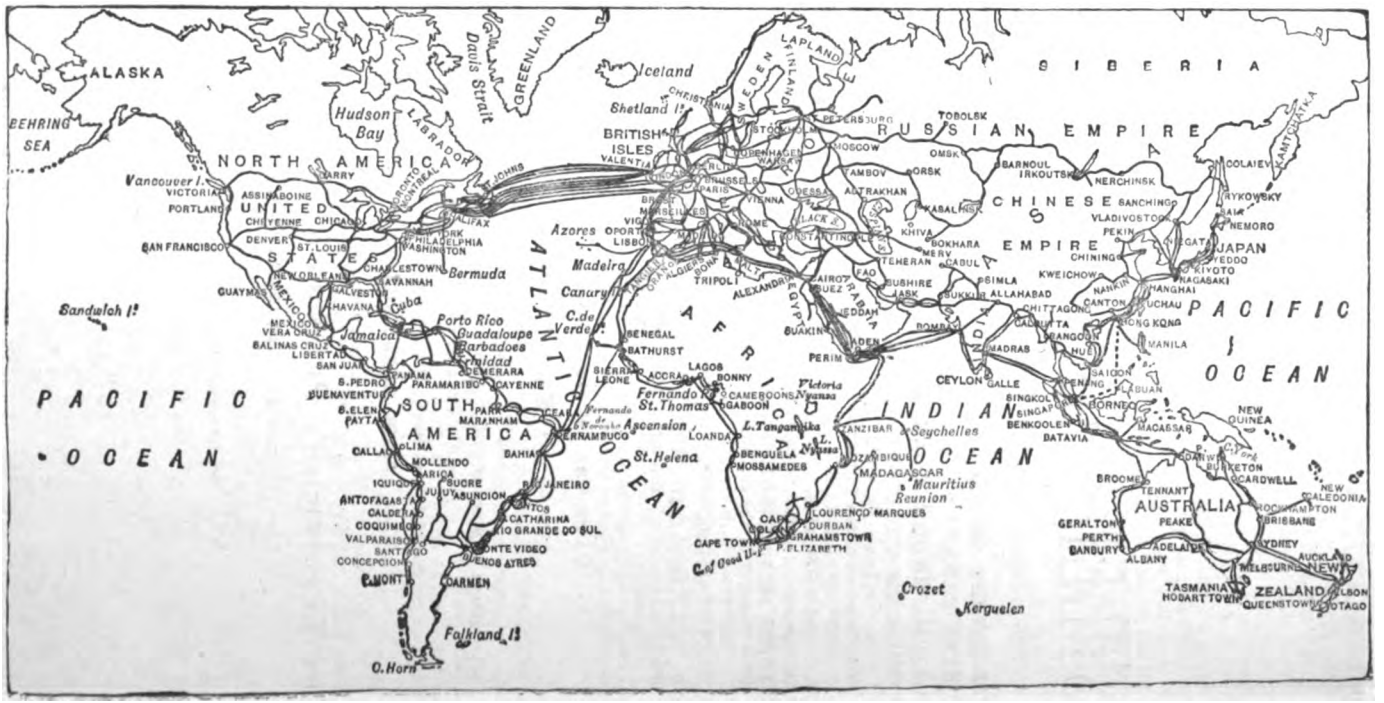
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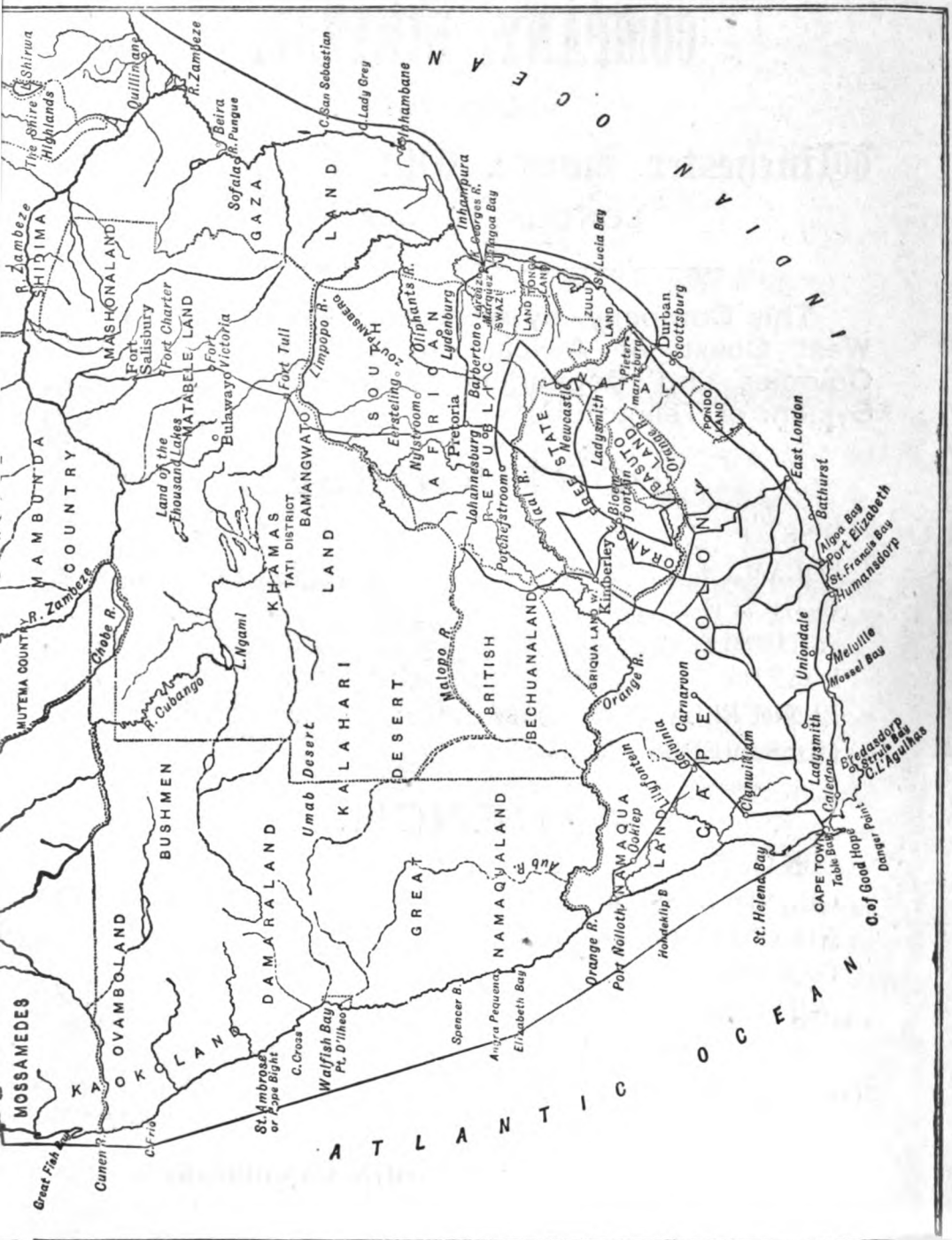
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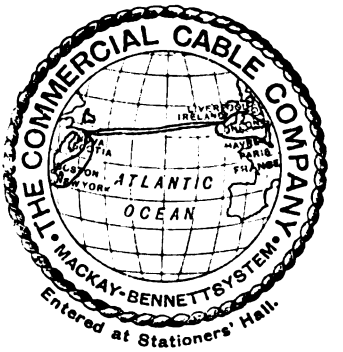

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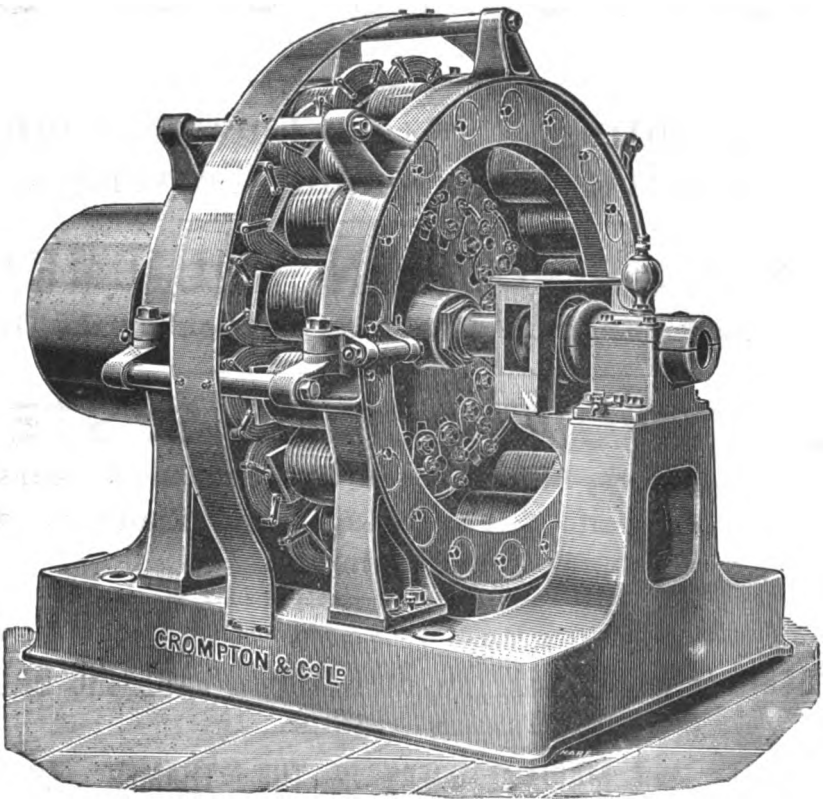

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